TEACHING PRACTICAL LESSONS USING MOBILE LABORATORY: A CASE OF SELECTED BASIC SCHOOLS IN ZAMBIA

BY

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Submitted in Accordance with the Requirements for the Award of the Degree of Masters of Education in Natural Sciences at the University of South Africa

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DECLARATION

I, **Chilando Grace**, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the Masters of Education in Natural Science Degree at the University of South Africa, Pretoria. It has not been submitted before for any degree or examination at this or any other university.

CHILANDO GRACE:

Signature......................

On the 8th Day of September 2017

PERVISOR:

Signature…………………………Date…………………………………………………

DEDICATION

I dedicate this piece of work to my late father Chishimba Edmond and my mother Mulenga Annie. I also dedicate it to my four daughters, my son and especially my supportive husband Richard Daka.

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APPROVAL

This dissertation by Chilando Grace has been approved for the partial fulfilment of the requirements for the award of the Degree of Master of Education in Natural Sciences by the University of South Africa.

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LIST OF ABBREVIATIONS AND ACRONYMS

CDC	Curriculum Development Centre
CPD	Continuous Professional Development
ECZ	Examination Council of Zambia
FEMSA	Female Education in Mathematics and Science in Africa
GRZ	The Government Republic of Zambia
ICT	Information, Communication and Technology
JICA	Japan International Cooperation Association
MOE	Ministry of Education
NAS	National Assessment
NSC	National Science Centre
SACMEQ	Southern African Consortium for Measuring Education Quality
SCOLs	Science Center Outreach Laboratories
SCORE	Science Community Representing Education
SMT	Science, Mathematics and Technology
SPSS	Statistical Package of Social Studies
STEM	Science, Technology, Engineering and Maths
STEPS	Strengthening Teachers' Performance and Skills
UNESCO	United Nations Educational Scientific and Cultural Organisation
UNISA	University of South Africa

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ABSTRACT

The purpose of the study was to explore teachers' views on using mobile laboratories when teaching Integrated Science during science practical lessons; to assess the teachers' competencies in using the mobile laboratories and the challenges they face in this practice. The research used a survey as a research design. The target population was all teachers teaching Integrated Science. The sample comprised of forty-five (45) respondents from Northern and Eastern provinces of Zambia. Purposive sampling was used to pick the participants of the study.

In collecting data, questionnaires, interview schedules and observation checklist were used to collect data needed for this study. The instruments were piloted before they were used in the study.

The findings from the study revealed that the quality of material in these laboratories are quite good but their numbers are not in line with the size of the classes, which negatively affects the teaching and learning process of practical lessons in science. Additionally, the teachers' qualification, was found to be associated with their competence in the use of mobile laboratories; that is, the higher the qualification, the more the competence in the use of mobile laboratories apparatus. Furthermore, the study established the following challenges on the use of the mobile laboratories: inadequate materials in the mobile laboratories, schools are not financially strong to replenish them after they are used up, some teachers find it time-consuming to prepare and set up the apparatus for experiments and orientation is needed for some teachers on how to use these laboratories.

In view of the findings, it is recommended that the government should provide more laboratory materials and monitor the level of usage of these materials. Additionally, short courses should be organised aiming at improving science teachers' knowledge and skills of the use of mobile laboratory facilities. Moreover, Continuous Professional Development (CPD) must be enhanced in schools with an emphasis on the orientation of mobile laboratories usage by all science teachers.

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CHAPTER ONE

INTRODUCTION

1.0 Background of the Study

The Government of the Republic of Zambia (GRZ) aspires to transform the nation into a medium income nation by 2030, as articulated in the policy document ‘Vision 2030’. This vision implies equitable access to safe water and other social services like education and health (GRZ, 2006).

All societies in the world have ways to educate the citizens to ensure that they become full participants in the society, are able to contribute and develop it and so become more human.(Savater,2004) In the world over, science education has been viewed as one vehicle that may enhance sustainable development (Lamanauskas, 2007). In the same vein, Science occupies an important place at various levels of the educational system in Zambia. As such, Zambia is undergoing rapid economic development and the education system is part and parcel of this change. The government recognises education as critical in enhancing economic development. One educational discipline which is recognised for contributing to economic development is science and technology education. The Government of the Republic of Zambia emphasises this when it points out that in order to accelerate economic growth, ‘the country needs to intensify the development and application of science and technology in its socio-economic development’ (GRZ, 2006).

However, most countries worldwide have their own problems and unique positions on school science education. This, in turn, needs to be researched on in different ways to understand the challenges and improve approaches to the educational process.

In Zambia, lower grades (1 to 4) and middle basic grades (7 to 9) levels pupils are exposed to Integrated Science which aims at helping them develop scientific skills, knowledge and attitudes. The current curriculum has been instrumental for instituting and teaching of science in schools and colleges as a basis for establishing a responsible citizens through been renovative. To achieve this the school system and the stakeholders have to see to it that effective and motivational aspects of science learning are employed not only in the classroom but in the wider societies. The Integrated Science syllabus requires teachers to use activity based approaches that enhance pupil’s creativity, analysis and problem-solving in and outside the classroom (CDC, 2003). The teacher is expected to demonstrate the lessons and this can only be attained through the practical lessons in integrated science. Based on Abrahams (2012) demonstration is an activity strategy where the teacher does some work and the learners venture to do it the way he has done it. Abraham embraces that this method is employed when the teacher wants the learners to do a piece of work the way he has done it and learn a little by listening, a little more watching but as a rule, learn most by actually doing the piece of work. Baines *et al.,* (2008) agrees with the citation pointing out that knowing how to present views and listening to the views of others is an important skill in life and one that work in science and need to be developed. Such debated necessarily draw on experiences from everyday life, bring in ethical and social dimensions to issues that surround the learners and their schools and help them connect the life within the classroom and outside school so helping their science become more applicable. This approach to teaching science suggests change in the attitude of learners towards science. Science teachers specifically in teaching of practical lessons need to take steps to explore reasons and to remove barriers to participation in classroom. While this trend may be clear and at times seem overwhelming studies show that learners in science education enjoy working with science ideas , especially when to investigate their own ideas and compare them with the ideas of standard science (Dahlin *et al.*, 2009).

Furthermore, science education can only be effectively taught under conditions where there is an adequate provision of teaching and learning materials. One major difficulty pupil's experience in science classes, particularly chemistry and chemistry-based components such as environmental science, concerns the scientific concepts learnt in class having no immediate link to what they see and use, or in short, everyday experiences (Dahlin *et al.*, 2009). On the contrary, to most pupils, chemistry is all about invisible concepts, and, therefore, it has a general reputation for being difficult.

Therefore, it is for this reason that the mobile laboratory was introduced at both primary and secondary school levels as a way of assisting science teachers in delivering science practical lessons to the learners. However, there has been a growing concern in challenges faced as a result of the use of Mobile Laboratories in the teaching of science practical lessons in primary schools.

It is against this background that this study sought to explore the teaching of practical lessons using mobile laboratories and establish the challenges which teachers encounter in the use of Mobile Laboratories when teaching science practical lessons in primary schools. The study is therefore an attempt to fill the gaps outlined above in the quest to find the solution on how well the Mobile Labs can be improved on to qualify the statement from (Dahlin *et al.*,(2009) which states that Science teaching predominantly requires a learner to be at the centre of the process of learning. As a student learning science gives a broader view of the world and ways of looking at that world as well as to change their worlds in education in science. Teachers are challenged not only to teacher the theoretical aspect of science but engage learners in practice to enhance their knowledge and a number of skills in the subject matter.

1.1 The Context

Zambia is made up of ten provinces namely; Northern, Eastern, Western, Southern, North Western, Central, Luapula, Copperbelt, Lusaka and Muchinga Provinces as shown in the map below.

Source: Sambia Karte Provinzen **(internet)**

According to the survey carried out by National Assessment (NAS) and Southern African Consortium for Measuring Education Quality it was (SACMEQ) it was revealed that there has been persistent poor performance of learners in schools, particularly in the areas of English, Mathematics and Science The results for the grades 8 and 9 survey conducted by the Examinations Council of Zambia (ECZ) revealed serious training gaps in teachers in terms content and pedagogy where teachers performed almost as good as their learners in English, Mathematics and Science. the review of the JSS Teachers' Diploma curriculum is timely so as to strategically address the teacher training gaps observed and those revealed by the NAS especially at junior secondary teacher education level in which content and pedagogy have been given significant attention. The revised JSS TE curriculum has taken into account the divergent aspects in the revised school curriculum to provide effective linkage between the college curriculum and school curriculum. According to 2013 Curriculum Review the JSS teacher education curriculum has therefore been designed to equip trainee teachers with the necessary knowledge, skills, competences, positive attitudes, values and pedagogical know-how required for the trainee teachers to implement the school curriculum effectively and bring about real learning in their learners. It is evidence that the new curriculum has been structured according to the ideas in scientists' science, which is from the perspective of students' learning and how their ideas might develop to those of standard science. This may seem ambitious, with important implications for stakeholders at all levels. However, evidence shows that the outcomes from such approaches show that they are well worth the efforts for students, teachers, parents and their communities, as well as at regional and national level.

In line with the above observations in Zambian context, the teaching of science is a challenge due to a lack of conventional laboratories in schools. Therefore, the mobile laboratories were introduced at both primary and secondary school levels as a way of supplementing science teachers in the delivery of science practical lessons to the learners. The National Science Centre from its inception in 1991 has been instrumental in distributing the Mobile Labs throughout the country especially in rural areas which are mostly lagging behind in terms of provision of conventional laboratories. MOE,(2015), report emphasise the government commitment to allocating more resource to the education sector in order to expand on access to Primary, Secondary and Tertiary education which is seen as a major factor in fighting poverty. It is reviewed that Jica supports the government of Zambia in ensuring that learners experience effective teaching and learning in science. In alignment with Zambia's development policies and programme Jica continue to prioritize Science and Mathematics as this will accelerate the overall social and economic development in the country.

The study was conducted in the Northern and Eastern provinces. The study population was from all science teachers in these two provinces because according to the Government of the Republic of Zambia, 2006, the two provinces are highly supplied with the mobile laboratories. Hence, the focus on those teachers who are teaching Integrated Science to the lower grades (1 to 4) and middle basic grades (7 to 9) levels.

1.2 Rationale

The rationale for this research study draws largely on contextual evidence based on learners' classroom practices. The researcher embarked on this study to give insight into the scientific method of practical work which emphasises the active involvement of the learners in their learning process as they are exposed to a wide range of teaching and learning activities. Teachers need to strive to present lively and stimulating lessons through practical approaches which not only develop the learners' investigative skills but generate real interest as well as equipping them with knowledge and understanding of key scientific principles. In this view the students are engaged in thinking about their own and others' thinking, thereby developing a metacognitive awareness of the basis for their own present thinking, and of the development of their thinking as they learn. Constructivism as a theory of learning and interactions that link conceptual, procedural and outcomes are used to critically examine the relationship between these different types of outcomes (Jonson, (2008). Additionally, Studies have shown that students' content knowledge, procedural knowledge, and knowledge about the nature and characteristics of scientific practice are developed together not separately;

Based on Abrahams (2012) practical work is quite efficient as it develops scientific attitude such as open mindedness and objectivity. The outlined reasons motivated the researcher to do the study on practical lessons in Integrated Science and this study will be vital as it will help to generate knowledge on how well mobile laboratories can be improved on by the stakeholders specifically the National Science Centre to propel the learning of science in the right direction.

1.3 Statement of the Problem

Through the Ministry of Education, the Government of the Republic of Zambia recognises the potential for science education in promoting technological development. It is for this reason that the Mobile Laboratories were introduced at both primary and secondary school levels as a way of assisting science teachers in delivering of practical lessons in science to the learners. However, there has been a growing concern that the use of mobile laboratories in learning of science practical lessons in primary schools leaves much to be desired. This is highly supported by Mzumara (2008), who clearly points out that the most common need for primary teachers is to broaden their science subject knowledge if they are to teach the subject effectively and confidently. There has been an observation that the learners face a number of challenges in terms of the number of these mobile laboratories which are far much less than the number of learners. According to CDC (2010), most primary and secondary schools do not have conventional laboratories to support practical aspects of teaching and learning. The bigger classes pose a challenge to the approach which can be used to cater for all the learners. Therefore, this study seeks to explore the challenges which teachers encounter in the use of mobile laboratories when teaching Integrated Science practical lessons in primary schools.

1.4 Objectives

The following objectives guided the study:

(i) Examine teachers' views on the effectiveness of Mobile Laboratories in the teaching of Integrated Science practical lessons in selected primary schools.

(ii) To establish the effect teacher competencies have on the teaching of Integrated Science practical lessons in selected primary schools.

(iii) Identify academic challenges faced by teachers in teaching Integrated Science practical lessons using mobile laboratories in selected primary schools.

1.5 Research Questions

The study is guided by the following research questions:

1. What are teachers' views on the effectiveness of mobile laboratories in the teaching of Integrated Science practical lessons in selected primary schools?
2. What effects do teacher competencies have on the teaching of Integrated Science practical lessons in selected primary schools?
3. What academic challenges do teachers face in teaching science practical lessons using the mobile laboratories in Integrated Science?

1.6 Significance of the Study

It is anticipated that this study would generate information which could contribute to the pool of knowledge for curriculum developers and education policy makers by revealing the challenges faced by the teachers in the teaching of practical lessons in science using mobile laboratories. The study will also go a long way to help teachers and other stakeholders on how adequately the mobile laboratories can be used in teaching practical science lessons so that they can know the areas of need in terms of teaching and learning materials provided.

Furthermore, the information generated by this study could be used by other researchers to help improve the use of the mobile laboratories so as to alleviate the problem of the way practical lessons are handled at the primary level of education. Additionally, the researcher is of the opinion that this study may further benefit learners in the sense that if learners are given the necessary guidance, they can become more aware of their own thinking processes as and when they study. This will enable them to develop and acquire strategies with which to direct their own learning. There is sufficient evidence that the use of mobile laboratories in the teaching of practical lessons in integrated science constitutes a major pedagogy for conceptual and procedural part in the learning process of science in schools.

With a result of the successful completion of this study, the National Science Centre would benefit from the information gathered from the research so as to improve on the quality of the Mobile Labs produced which are very beneficial in the teaching of practical lessons in integrated science. This will not only assist the teacher in the process of teaching but will enhance the acquisition of the necessary skills by learners allowing them to become directly involved in the learning process rather than remain inert.

1.7 Scope and Delimitation of the Study

This study was concerned with finding out the views on using mobile laboratories when teaching Integrated Science during science practical lessons; to assess the teachers' competencies in using the mobile laboratories and the challenges they face in this practice from selected schools in Eastern and Northern provinces of Zambia.

1.8 Limitations of the Study

Some impasses are expected on the course of this study. Among these are the fact that only a few secondary schools in Eastern Province of Zambia were equipped with the mobile science laboratories and these were the only ones considered. The purposive sampling was also used in this study, which also limits the generalisation of the study results. Therefore, the results may be generalised to other schools in Zambia only with caution. Nevertheless, the results are valid and can still be taken into consideration for research and planning purposes.

1.9 Theoretical Framework

There are a number of theories and perspectives which address the teaching of science in a classroom. However, the theory that guided the study is constructivism. This theory according to Hodson and Hoften (2012) propose that constructivism is a major learning theory and is applicable to the teaching and learning of science. The learner in this theory actively constructs or builds new ideas and concepts based on prior knowledge and new information. The theory emphasises the teacher to be a facilitator and this is prominent in the teaching of practical lessons in science. The theory is concerned with strengthening, examining the strength and weaknesses of the content, and how the content has to be presented to the learners so as to grasp the concepts through practice. Abraham and Millar (2008), in addition, postulate that these relationships are grounded in the knowledge and awareness of the similarities and difference in the learner's backgrounds, experiences and current views of science. These expectations are a foundation for the teacher to integrate a theoretical framework of teaching and learning into a practical structure for a sequence of activities which the learner has to be engaged in. Seymour Paper (2008) student of Piaget asserted that constructivism learning occurs particularly well when a learner is engaged in constructing a product. This is evident when learners actively interact with scientific ideas through practical lessons to enhance new knowledge and understanding which develops through continual and dynamic collaboration with scientific theories. Research on effectiveness of Practical lessons in integrated science focuses on instructions that promote students involvement and creation of scientific knowledge through the activities which learners are exposed to. Muzumara (2008) proposes that constructivism is an approach that shows how school science can make significant contribution by outlining a view of science that deals with the challenge of ways of learning. This is in line with UNESCO (2010) where evidently is pointed out that access to quality education has been recognised through learner centred approach which calls for the learner to be at the pivotal to use the opportunity that school offers to attain quality education. In his study Johnson (2008) postulates that learners are capable of learning through experience construct their own ideas thus making connections with the real world and seeing how science applies to them. This calls for teachers to use teaching strategies that promote independent thinking for the learners. Practical lessons need to be taught effectively in classrooms and learners are expected to become critical thinkers. Based on the study on practical lessons a teacher serves the function of a facilitator assisting the learners to demonstrate that they are able to experiment and use different science proceed skills. According to Johnson (2008) constructivism promote basic science process skills which apply to foundational cognitive function in the primary grades.

Additionally, Vygotsky’s concept of social constructivism promote learning through scaffolding, elicitation and making connections and provide an underpinning for thriving language development. He goes on to emphasise the role of community, social interaction and instructions when teaching which can be hugely beneficial for a learner’s development. Johnson (2008) affirms to the view and points out it is through that primary science provides plenty opportunity for learners to adapt firstly by observing their peers and secondary when teachers discuss with them ways in which learning can be improved, reflecting upon evidence and the implication of their development. Muzumara (2008) conquers that through this theory science challenges children at an early stage as it allows them to think and always try the best they can. The constructivism approach claims that existing knowledge of a learner is of great importance in the learning process and that learning occurs through cognitive and social processes. In the study Johnson (2008) cites that this approach stresses the individual creation of knowledge and construction of concepts which may be very useful to the leaner. The researcher is with the view that constructivism accords the learners to overcome misconceptions and encourages them to discuss a variety of ideas about particular scientific topics. This enlightens the teacher to recognise learners' misconceptions, classify skills which can be applicable for them in future. Millar (2010) evidently echoes that the main focus when teaching science through practical is based on the guidelines which are representatives of the curriculum and will determine how the content affects a child's knowledge, skill and understanding. This implies that teaches should facilitate learners learning processes by creating conducive environment for them to construct their knowledge. Johnson (2008) emphasises that small-group instruction "stimulates higher levels of thinking, encourages articulation of thinking, helps learners remember, allows learners to make connections and see different perspectives, as well as promotes deeper understanding." It is this deeper level of understanding that the researcher believes must be promoted via changes in teaching strategies such as practical activities, field trips, ICT models presentations and many more.

In Zamia, the 2013 Curriculum Frame work attains this fact that learners are accorded an opportunity to align themselves to execute scientific experiments when they engage in inquiry activities. The Revised curriculum encompasses the constructivism theory which supports the scientific experiments and the process skill of experimenting in particular. The researcher is of the opinion that inquiry should encourage learners to be inquisitive, curious and ask questions in a given situation and try to search for solutions by themselves. The learners are taught in context through practical work and the purpose for which the learning is being carried out are clear to the learners as they are engaged in thinking about the science they are doing during the learning tasks.

1.10 Operational Definition of Terms

Competence is the ability to do something efficiently.

Effectiveness is the ability to produce the desired result or ability to produce the desired output.

Integrated Science: a course study offered at primary level which comprises of Biology, Chemistry and Physics.

Laboratory: a place where necessary equipment, chemicals and required facilities are available for a science teacher to perform experiments.

Mobile Laboratory is a movable laboratory which is fully housed with required materials and equipment for the teaching of science.

National Science Centre: a centre where Mobile Laboratories are being manufactured and distributed in Zambia.

Practical Lesson: a task in which learners manipulate real objects or materials which teach laboratory skills to enhance the learning of scientific skills.

1.11 Assumptions

This research was conducted on the assumption that Science teachers cooperated with the researcher to gather information within their respective institutions on their views on using mobile laboratories when teaching Integrated Science during science practical lessons. As respondents, they would give correct accurate information to the questions on the questionnaire, be observed while teaching a practical lesson in Integrated Science and be interviewed by the researcher. It was also assumed that there was enough time to carry out the research and the environment was conducive as well.

1.12 Research Design and Methodology

In this research, a survey design was used in collecting data. According to Zikmund (2003), a survey is a research technique in which information is gathered from using a questionnaire. The researcher mainly employed a quantitative method in collecting data with the use of a well-constructed questionnaire whose questions solicited the desired information. Observation and interview schedules were employed to collect qualitative data. The study adopted purposive sampling as participants were selected according to selected criteria relevant to the research questions (Ivankova, Creswell & Clark, 2008). A study sample of forty-five (45) teachers who teach Integrated Science at primary school level was purposively selected from Eastern and Northern provinces of Zambia. This will be explained further in Chapter three. In collecting data for this study, the three methods used were a questionnaire, interview schedules and observation checklist. The analysis of data was made using appropriate qualitative techniques, explained further in Chapter four.

Permission for conducting the research was requested from the Ministry of General Education through the Provincial Education Officer (Appendic). Confidentiality was upheld by ensuring that the identification of the participants was concealed. To ensure that anonymity was upheld, no data that would be used specifically to trace the identity of any participant was collected. The participants were not coerced; they were given the choice to participate voluntarily and the freedom to withdraw from the study at any time without giving reasons. The purpose of the study was explained to the participants, with a consent form (Appendix F) provided for them to sign.

1.13 Structure of the Dissertation

Chapter One presents an introduction and background to the study, the statement of the problem, objectives, research questions, significance of the study, limitations, theoretical framework, operational definitions of the concepts as well as the overview of the research design and methodology.

Chapter Two presents the review of the literature used in the study firstly has covered a brief history of mobile laboratories in Zambia then on three main themes deduced from the objectives, namely; the effectiveness of mobile laboratories the effects of teachers' competencies and the academic challenges faced by teachers in teaching Integrated Science practical lessons using mobile laboratories

Chapter Three presents the research methodology and outlines the sampling procedure, data collection, data analysis, methods, validation and reliability instruments and ethical considerations.

Chapter Four presents the analysed data and the results of the study. Discussions of the major findings of the study are presented in

Chapter Five presents the findings from the Literature and the study.

Chapter Six presents the summary, implications and conclusions of the study.

1.14 Chapter Summary

This chapter has covered the introduction to the study. It focused on describing the process of the study beginning with the background to the study, then the statement of the problem and the purpose of the study. The chapter further covered objectives of the study and study questions, the significance of the study, delimitation, limitation and the theoretical framework of the study. The chapter also highlighted the operational definitions of the key terms in the

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter will present a brief history of mobile laboratories in Zambia, the effectiveness of mobile laboratories in primary school teaching of practical lessons to learners and the academic challenges faced by teachers in teaching Integrated Science practical lessons using mobile laboratories.

2.1 A Brief History of Mobile Laboratories in Zambia

In the modern world, we cannot do away with science. The significance of science cannot be over emphasised seen through the many benefits that humanity has continued to derive from various fields like medicine and agriculture. However, the teaching of science has been a challenge worldwide due to a lack of conventional laboratories especially in rural areas as they are still decades behind due to lack of these facilities. The absence of laboratory equipment means that learners are not able to conduct practical experiments as required in the curriculum which adversely affects their overall performance and understanding of the subject matter. However, evidently, a number of projects tailored specifically at improving the teaching and learning of science globally are observed. For example, Science Center Outreach Laboratories (SCOLs) have been established in recent decades in many countries around the world, including Australia, Finland, Germany, Ireland, Israel, New Zealand, and the US (see Bolstad, Bull, Carson, Gilbert, & MacIntyre, 2013; Gomes & McCauley, 2012; Tytler, Osborne, Williams, Tytler, & Cripps Clark, 2008). Science Education Pakistan Group (SEPG) is a project whose aim is to provide access to scientific equipment and enable students in villages in Pakistan to perform experiments using a mobile science laboratory. Kusile School Mobile Science Laboratory in South Africa addresses the lack of science laboratories not only in that country but in many African schools.

In all these aspects, mobile laboratories avail learners a hands-on teaching methodology which encourages and provides them with the opportunity to participate in scientific experiments in the classroom to understand scientific theories and their application in line with the school curriculum. Learners are encouraged to participate fully in lessons, making the learning experience practical and enjoyable. Participation is key to learning achievement. According to Suttan *et al*., (2008), cite that the more an individual participates, the more he/she understands; and the more he/she understands, the more he/she learns. Learning by doing, learning by participating, learning by sharing are various aspects of the new teaching/learning process. Both male and female learners are exercising, expressing interest, in a friendly conducive environment. The freedom in the classroom impacts on the creativity of the learners as well as the teacher. In this way, learning becomes a joyful process of knowledge and competencies acquisition and consequently, a new cooperative spirit is emerging which depicts the learner centred approach (Belington, 2007).

This results into learners becoming the major actors in the classroom. They touch, observe, manipulate, measure, evaluate, interact, take initiatives, produce and explore the subsequent steps and way forward for a particular lesson. From being passive learners, their profile changes to become that of achieving learners. This change in profile is directly related to the change in the teacher's profile as both teachers and learners have pleasure in the teaching/learning process. It is believed that in order for learners to understand the basics and develop an intuitive understanding of science, the material experiments and visuals are of importance. This results in learning which becomes attractive and a lively human activity.

It's from this background through the government policy objective for science and technology where Zambia as a country sort the importance of revamping the learning of science and mathematics. In 1991, the Ministry of Education with funding from the Japanese International Cooperation Agency (JICA) established the National Science Centre (NSC) whose mandate is upgrading the teaching of Science, Mathematics and Technology (SMT) subjects (https://www.lusakatimes.com). To achieve this mammoth task, the National Science Centre embarked on the production of mobile science laboratories and other low-cost teaching and learning aids/materials and in-service training of teachers. The mobile laboratory has been designed to move from one classroom to another with convenience (see Appendix H).This answers the call to improve Science, Technology and Mathematics Education, where there is the availability of appropriate teaching/learning materials to help the teacher and enable concrete learning process for the learners. The hands-on learning coupled with reports and presentations will allow learners to re-enforce the scientific concepts that they have learned and improve their communication and presentation skills which are vital to their education. The group dynamics and team building skills will also equip them with life-long skills, which can help them in their career in future (Hausamann, 2012). For example, the acquired new skills and competencies will enable them to develop as future scientists, engineers and technicians.

In addition to the distribution of the science kits, laboratory equipment and chemicals are procured and distributed for teaching and examination purposes (Curriculum Development Centre, 2010). Furthermore, a number of teachers and lecturers from colleges of education are trained in the appropriate and innovative use of the kits in the area of teaching Integrated Science to the learners. This is cardinal because quality teacher training in Science, Technology and Mathematics lays the foundation for relevant teaching/learning process in the classroom and outside the classroom. More specifically, such a teacher becomes an asset as he/she will put the concepts to the learners in an acceptable manner for them to understand the physical, chemical and biological processes around them (Schwan *et al*., 2014). They can apply their learning to environmental issues with focuses on a problem-solving approach which supports the learners to prepare as future nation builders who devour the responsibility to find a solution to the challenges facing the society and the world in general.

This distribution of mobile laboratories to different provinces throughout the country is hoped to propel the teaching of practical in Integrated Science. This is in a bid to counter the trend of poor performance in sciences amongst pupils in the country. This will not only enhance the acquiring of skills in learners but also raise the staff morale to be more inclined to try out new ideas in the area of practical presentations of lessons (Muzumara, 2008). It is the responsibility of the science teacher to identify, integrate and correlate the different aims of science education in order to maximise learning opportunities in science. Laboratory work, especially to a learner, promises to be effective for knowledge acquisition because it can extend the learning that occurs in school (Schwan *et al*., 2014). This is a practical way to complement teaching at school and out-of-school for the learners to understand scientific theories and their applications in line with the school curriculum. They are encouraged to participate fully in the practical hence making the learning experience practical and enjoyable.

Additionally, the National Science Centre publishes the *Zambia Journal of Teacher Professional Growth* which is the first journal on teacher professional growth in Zambia with support from JICA through the Strengthening Teachers' Performance and Skills (STEPS) project. The focus of the journal is on policy, practice and research in teacher professional growth in Zambia. The National Curriculum Framework has brought on board the policy on Science and technology to actualise it in schools through learning of practical lessons in science. The study of Schwan *et al*., (2014), review that the ability of any society to acquire knowledge, skills and technology that would make it build the capacity to meet social and economic needs is vital for its development. Science and technology are fundamental to sustain socio. Economic development of any nation. More importantly also is the fact that learning to teach and mastery in teaching is a function of time and experience coupled with support from colleagues and other proffesionals. Muzumara (2008) affirms that it is essential to consider that growth in the profession requires a variety of life experiences in a teaching career. This avails the information to all stakeholders on how to deal with the teaching and learning of science in order to come up with ways and means to sustain the teacher who is at the centre in line with the National Science Centre to bring to light the valid information to teach science effectively.

2.2 The Effectiveness of a Mobile Laboratory in Primary Schools

The most important focus of science education is to prepare students to acquire scientific knowledge that they will apply in everyday life (UNESCO, 2010). This is also in accordance with the competence based curriculum which is followed by Zambia. This implies that science teaching ought not just to convey collection of facts to the learners but also a way to think about the world outside the classroom. Therefore, teaching science has to be concerned with developing analytical, critical observation and problem solving abilities as well as the creativity of an individual (Lemke, 2008). These abilities are less developed through traditional approach because in traditional approach hands-on activities have no place to play. In the traditional approach, learning is focused on mastery of content knowledge, with less emphasis on the development of skills and the nurturing of inquiring attitudes (Crebbin, 2004). Thus, traditional education is more concerned with preparing students for the next grade level and in school success than helping them to learn through their life experience.

To prepare students to become scientist, science should be taught through process skills (Gilbert, 2006). Proper understanding of science concepts is achieved through practical activities which enable students to acquire important scientific skills such as collecting and recording data, communicating, analyzing and making inference (Hofstein&Lunetta, 2003; Hofstein, 2004; Jorgensen, 2010). This is what is known as learning science by process skills (Gilbert, 2009). Given this fact, process skill in teaching science connects learners with the use of the five sense organs. Therefore, laboratory resources become essential in teaching and learning science because they enable teachers to employ learners' process skills. Unfortunately in most Zambian basic schools, the availability of laboratories and resources are still a big challenge and this fact might restrain teachers from teaching science effectively.

Various Research findings indicate that for effective teaching / learning to take place, the learning environment of the pupils must be taken into account. For effectiveness to occur, the learning also has to be consistent, not only with the Science and Technology Curriculum but also with the various other aspects of science learnt in the classroom. Since the curriculum is designed in relation to the national development goals, and objectives of the educational policy, the teacher should be aware of the contents of the curriculum, and be able to derive his or her daily work in relation to the curriculum (Hausamann, 2012). As a result, all learners in the country will be led towards the same national goals through defined learning acquisitions in Science and Technology Education. Additionally, Muzumara (2008) echoes that different factors are considered by researchers for the effectiveness of mobile laboratories. He points out that people have to construct their own meaning regardless of how clearly teachers or books tell them things. Mostly, a person does this by connecting new information and concepts to what he or she already believes. Concepts—the essential units of human thought—that do not have multiple links with how a student thinks about the world are not likely to be remembered or useful. Teachers should be concerned with developing scientific attitudes. According to him, these are essential as they act as the driving force in learning scientific knowledge and skills and applying them in a different context. School science necessarily implies practical work of different sorts. For a number of reasons, both for managing the class and for good pedagogical reasons, students work in groups to carry out science investigations. Given appropriate for all Quality Learning to do. Through science learning, learners will learn to define, refine and resolve problems and ideas Ryan(2003). They will learn to do this through practical data gathering, collecting information from a range of sources, transforming that data to make broader generalizations, explaining their outcomes and justifying their positions. They will start to realize the limits of their data and their arguments and how they might be developed further. They will be developing their powers of logical reasoning. There should be a balance between theoretical education and practical teaching. Practical education certainly has a deeper impact as it provides learners with a broad based curriculum with adequate scientific knowledge and skills. Suttan *et al.*, (2008), stated that good practical work engages students to develop important skills, understand the process of investigating, and develop the understanding of the scientific concepts. These advanced reasons bring to light how this highly practical lessons can increase the learner's effectiveness as a learning experience and enable him/her to apply scientific knowledge hence stimulating and engaging learners to learn at different levels. Hausamann (2012) stresses that Concepts are learned best when they are encountered in a variety of contexts and expressed in a variety of ways, for that ensures that there are more opportunities for them to become imbedded in a student's knowledge. The teacher has to take into account the fact that practical work is part and parcel of what teaching and learning science is all about. Suttan *et al*., (2008) further postulate that teachers should adopt a more hands-on approach to teaching. This direct involvement in scientific activities in the laboratory avails the learner the acquisition of a range of cognitive and psychomotor skills and processes. From the perspective of science, learners should develop key ideas and understand their interconnectedness, such as the relationship between the macro and micro-structures of materials and their properties, the concept of energy, ideas about cells and interdependence in biological systems. This knowledge is accepted by engaging in practical work themselves which they have built on the available knowledge following accepted methods being applied. This avails the learners the opportunity to think about and apply science concepts and to formulate complete thoughts which assists them to form references, helping learners to express their questions and answers; and helping them develop investigations that will lead to answers (Osborne, and Collins, 2000). Teachers should take care to use appropriate approach may result in coverage of the content, of which learners will have a deeper understanding of the material covered and will, ultimately, learn more because they learned not only some science concepts but also how to solve problem independently. Demonstrations by teachers should be limited to use as summaries of what has been covered (Suttan *et al*., 2008).They should not be used to convey new information because the purpose of the inquiry/discovery technique is for learners to find out science information through their own efforts. It is viewed, in Zambia, that the outlined aspects can be attained through the application of the mobile laboratories in schools, a responsibility accorded to the government as has been already alluded to.

In another study the realisation that scientific knowledge and experiences are of some value in the process of establishing a sense of personal and societal identity which is of paramount importance (Lamanauskas, 2007). All teachers hold personal beliefs and dispositions about teaching, learning, and learners. Some teachers believe their responsibility is to teach the material, and the learners' responsibility is to learn what is taught. Suttan *et al*., (2008) claim that hands-on learning experiences are key to the development of skills and the tying together of practical and theory. Making the separation and links between theory and practice is something that is best made visible to develop learners understanding. Good quality practical work can not only engage students with the processes of scientific enquiry, but also communicate the excitement and wonder of the subject. The researcher's opinion conquers with the view because tteaching practical lessons is related to the core activities in the learners spheres and is a key component of the investigation to acquaint the learner with qquality basic science education does not exist in isolation in schools. Outside schools there are many contexts where students meet and learn about science such as television, films, newspapers, museums, and the internet. Practical lessons are beyond the Classroom. Scientific organizations and associations of professional scientists rise to this challenge by providing resources for schools, frequently subsidizing materials or making them available on the internet. Suttan *et al*., (2008) assert that quality science education for all has its contribution to developing ways of thinking. Many scientific ideas are counter-intuitive as we know from many investigations. Haussmann (2012) has shown in a variety of contexts that thinking scientifically helps develop new ways of thinking; it widens and deepens our capacities to think. Thinking about and with scientific ideas means there is need to think in new ways that offer powerful possibilities for the future, and are not often spontaneously available without teaching. This idea of Science education would also open up the possibility for more and more citizens to experience the joys and delights of the human enterprise that we call Science and to feel part of it. This is a pressing argument in favour of an urgent reformulation of science teaching and learning. With evidence from surveys carried out learning of science has to emphasise working with ideas rather than transmitting information through scientific investigations of learners own ideas related to ongoing , current scientific issues of the day. This more realistic view of science ought to be one of the desired, explicit outcomes of school science, through teaching and learning. Thus, learners will develop a more realistic understanding about the nature of science and how it operates. They will be able to see science as part of the rich heritage that previous generations have bestowed to us, a living, growing corpus of ideas, that are subject to change as new observations and ways to interpret them appear. Such a science is not a rigid body of unchanging truth but a science that offers us knowledge, understanding and methods of working that offer powerful ways to look at the world (Abrahams, and Millar 2008). It connects with other curriculum subjects and with the lives of the learners in and out of school and their communities. Such a view of science should sound with the interests of the learners and encourage them to continue studies in science. They will then have a wider range of options available when they enter the world of work. In this way, quality basic science education contributes to reducing inequalities by providing wider possibilities for future citizens.

According to UNESCO (2010) report it is pointed out that all over the world, we are living through a transformation of the global economy. At the start of the twentieth century, the world's economies were based largely on agricultural production and natural resources, then on industrial production and transformation, then on services. Towards the end of that century, and certainly from the 1990s, the current, and probable future scenario, is the knowledge economy (SCORE, 2010). This spectacular change has been brought about by a number of elements that are both causes and effects of this transformation. In practice, in today's society, enormous and growing quantities of knowledge are produced and made available and the advances in ICT are a key driver in this phenomenon, so much so that the products of the industrialized economies now integrate significant scientific and mathematical knowledge(Abrahams, and Millar, 2008). The exchange of and access to information, previously reserved for a few, can now be available to all. Research has shown that this revolution has also brought about profound change in the world of work and the knowledge society. The researcher is of the opinion that schools have to help learners acquire an active repertoire of generic and specialist competences through the presentation of lesson with ICT which will take on the challenge to suggest some ways to move forward with technology. Studies have shown that low information literacy coupled with inadequate access to ICT and other sources of information imply that levels of awareness on issues that affect humanity become very low.

Furthermore, understanding the meaningfulness of science and technology subjects in relation to everyday life and to the major challenges facing the society is of a crucial dimension of any effective learning. If science and technology were to help improve the quality of life, learners should understand how it is. This trend is likely to increase in the medium term and offer an invaluable resource for learning UNESCO,(2010). However, teachers will need to learn how to select, adapt and use these resources to suit their purposes. This poses a significant cant challenge as a number of teachers lack the technological use of ICT (Gilbert, 2010). Based on research specifically from developed countries it has been echoed that one obvious benefit for the classroom is the use of the Internet and the range of materials that are freely available to support teacher learning as well as materials for use in the classroom. Based on research findings sources such as www.youtube.com/education or www.diffusion.ens.fr among other websites, offer materials to support teacher training. Many of the science museums of the world have websites that offer support in developing both scientific processes, and science knowledge and understanding, for example www.exploratorium.edu/ or www.cite-sciences.fr. Often such sites offer the possibility to consult a scientist about learners' or teachers' difficulties to meet inevitable challenges in the classroom (e.g. http://askascientist.org/). Such facilities are particularly important when dealing with the science of everyday life and the way that scientific c ideas apply in different circumstances. For the non-expert, which includes most teachers, faced with the rapidly expanding knowledge of science, the issue is usually deciding which scientific ideas to use to explain everyday phenomena. Once the appropriate ideas are made clear, understanding becomes much easier. For example, Practical work in physics is important in *showing* things to learners, as well as giving them an experience or feeling of a phenomenon, particularly an abstract one such as momentum. Experiments can sharpen students' powers of observation, stimulate questions, and help develop new understanding and vocabulary. Gilbert (2010) ascertains that practical work plays a particularly important role in developing learners' understanding of the physical world around them. Everyone remembers a number of dramatic practical activities from school – often demonstrations or activities with unexpected outcomes. These vivid memories of dramatic events can help learners to retain scientific knowledge. From the study Gilbert (2010) suggested number of explanations for engaging learners in a practical lesson in science one of them being to encourage accurate observations and description. This does not only arouse and maintain earners interest but goes on to promote logical and creative reasoning. Many studies in science suggest that effective learning often requires more than just making multiple connections of new ideas to old ones; it sometimes requires that people restructure their thinking radically. That is, to incorporate some new idea, learners must change the connections among the things they already know, or even discard some long-held beliefs about the world. The alternatives to the necessary restructuring are to distort the new information to fit their old ideas or to reject the new information entirely. Lemke (2008) echoers learners that come to school with their own ideas, some correct and some not, about almost every topic they are likely to encounter. If their intuition and misconceptions are ignored or dismissed out of hand, their original beliefs are likely to win out in the long run, even though they may give the test answers their teachers want. This calls for practical lessons Provide students with opportunities to brainstorm ideas about science and encourage them to wonder and talk about the natural world in relation to the activities being carried out (Lemke, 2008).Mere contradiction is not sufficient; students must be encouraged to develop new views by seeing how such views help them make better sense of the world. Every topic of the curriculum addresses, at least, a specific developmental issue at local, national or global levels. For instance, in learning about pressure, the learners should be guided to link it with the necessity to make safe water available to the community in every household. The learning has to be outcome based in order to link classroom activity to the community (Hausamann, 2012). For example, in environmental issues, deforestation is a threat to the whole community; it undermines the ecosystem and causes drought in the medium and long terms. Learning about air is an opportunity to highlight the effects of pollution on individual and public health, and the climate globally. The more the topics are meaningful to learners, the more effective the learning process will be and the more motivated the learners will be. In another study done by Abrahams, and Millar (2008) on practical work in science, it is important for the teacher to know the pedagogy. Additionally, effective pedagogy is at the heart of improving the quality of practical work in science (Muzumara, 2008). When well-planned, practical work and effectively implemented, stimulates and engages students' learning at varying levels of inquiry challenging them both mentally and physically in ways that are not possible through other science education (Clark, 2009). In addition, teachers need to be educated on pedagogies that are likely to help girls learn better as a way of improving practical work this emanates from the fact that girls mostly have a negative attitude towards science.

Research findings in this era reveal that the use of Information, Communication and Technology (ICT) is a vexed question that exposes inherent tensions. Muzumara (2008) ascertains the claim by bringing to light the constraints which African countries face in terms of those schools which face the challenge of not electrification of which Zambia is no exception. This poses a very big challenge to a pupil who is expected to fit in the new technological era. There is, however, an underlying consensus that ICT should supplement and enhance practical work not replace it. The speedy advances in technology have been claimed to offer a wide range of new opportunities for innovative science education (Barton, 1998; Lunetta, 1998). In this context, the learner will have enough drive in the learning of science because ICT will popularise science among schools as it involves application and deals with real life situations through practical experiments (www.score-edu.org).

Researchers (Gall, Gall, & Borg, 2007) posit that there are many skills and tools that are common to any science laboratory, as well as many dangers. Thus, safety precautions, skills and tools should be the first considerations when modifying any experiment many studies point out that safety should be considered and is particularly important in the primary sector in order to ensure the safety of pupils. (Belington,(2007) emphasises that mostly primary teachers may be less familiar with some activities than secondary teachers who are subject specialists. Therefore, teachers must ensure the safety of learners once in the laboratory and this is cardinal for every learner. For example, laboratories must have well-organised storage of chemicals and well-labelled power cords. Such organisation helps the learners to be interested in the subject because they are able to manipulate the equipment. To ensure the smooth safety when conducting practical lessons in science, the teacher has to keep an eye on all the learners (Belington, 2007). The researcher is with the view that what matters is the nature of the activity and the circumstances in which it is being undertaken. Although some activities are inherently more hazardous than others, all practical activities can become hazardous in some circumstances due to factors such as pupil misbehaviour, poorly designed work areas, inexperience of teachers as well as ability of pupils. Gilbert (2010) ascertains that many students are fearful of using laboratory instruments and other tools. This fear may result primarily from the lack of opportunity many of them have to become familiar with tools in safe circumstances. Findings from a study confirms that girls in particular suffer from the mistaken notion that boys are naturally more adept at using tools. Starting in the earliest grades, all learners should gradually gain familiarity with tools and the proper use of tools. By the time they finish school, all learners should have had supervised experience with common hand tools, soldering irons, electrical meters, drafting tools, optical and sound equipment, calculators, and computers.

However. It the duty of the teacher to see to it that various ways are employed in which safety can be improved by modifying the way the activity is carried out. These include not using the equipment in that particular way; undertaking teacher demonstrations instead of allowing pupils to do activities themselves; having only some of the class undertaking practical activities at one time; reducing the number of pupils - but not simply by excluding disabled pupils or those with special educational needs - or increasing teacher staffing or non-teaching support(Gilbert, 2010)

Many studies have highlighted interactive sessions, experiments are important features of practical education which ensures the involvement of learners and makes them understand more. This can be attained through ggroup approaches, the norm in science, have many advantages in education; for instance, they help learners see that everyone can contribute to the attainment of common goals and that progress does not depend on everyone's having the same abilities. Researchers (Gall, Gall, & Borg, 2007) emphasise on group learning approach has motivational value and Science teachers are encouraged to exploit the rich resources of group work and involve all the learners in useful ways. It is also important for teachers to recognize that some of what their learners learn informally is wrong, incomplete, poorly understood, or misunderstood, but that formal education can help students to restructure that knowledge and acquire new knowledge. Practical activities should avail learners with sense of success in learning science and they should deemphasize getting all the right answers as being the main criterion of success. Gilbert (2010) echoers that understanding anything is never absolute, and it takes many forms. Accordingly, teachers should strive to make all learners particularly the less-confident one are aware of their progress and should encourage them to continue This means that teachers must take care not to convey the impression that they themselves or the textbooks are absolute authorities whose conclusions are always correct. By dealing with the credibility of scientific claims, the overturn of accepted scientific beliefs, and what to make out of disagreements among scientists, science teachers can help learners to balance the necessity for accepting a great deal of science on faith against the importance of keeping an open mind. Research findings recommend that the science classroom ought to be a place where creativity and invention—as qualities distinct from academic excellence are recognized and encouraged. Indeed, teachers can express their own creativity by inventing activities in which students' creativity and imagination will pay off. Belington (2007) postulates that interactive education creates a deeper understanding of the subject matter .Researchers (Gall, Gall, & Borg, 2007) posit that collaborative nature of scientific and technological work should be strongly reinforced by frequent group activity in the classroom. Learners should gain experience sharing responsibility for learning with each other. In the process of coming to common understandings, learners in a group must frequently inform each other about procedures and meanings, argue over findings, and assess how the task is progressing. In the context of team responsibility, feedback and communication become more realistic and of a character very different from the usual individualistic textbook-homework-recitation approach (Belington, 2007).In helping learners to learn science practically, they should have necessary equipment which will make their learning very effective (Scott, 2010). This is essential because as science teachers understand the meaning and nature of science, it creates a clear picture of what they teach and how best the learners learn it. In the long-run, the practical involvement avails the learner the acquisition and application of knowledge, understanding and skills of scientific enquiry capability and testing of ideas. This qualifies the aspect that Learning should be whole, authentic, and "real": where Piaget helps us to understand that meaning is constructed as children interact in meaningful ways with the world around them.

2.3. The Effects of Teacher Competencies on the Teaching of Integrated Science Practical Lessons

Studies from the implementation of the curriculum points out that competencies denote a set of conscious, trainable skills and abilities which make a teacher effective (Czerepaniak, 2004) Competencies are addressed in the context of changeability and uniqueness of each and every educational situation and mean a repertoire of knowledge, personal features, responsibility, ethical engagement and educational techniques. Czerepaniak (2004) conceptualises competencies as developing in the space of practice. Among the competencies identified are communication and the competencies that pertain to didactic and educational skills. To demonstrate such competencies, Czerepaniak (2004) suggests that it would require a teacher to use basic instructional means and measure, including various methods and forms of classroom teaching, learning and course work, adjusted to both the educational goals and educational settings. Suttan *et al.,* (2008) also hold the view that communication competencies include the teacher's capacity to use various discursive techniques. There are expectations that science teachers at all levels in the education system acquire specific competencies during learning for them to operate effectively and confidently. They need to display some abilities and skills in their daily discharge of duties. This will result in a teacher making sound decisions relying heavily on a teacher's knowledge of students' cognitive potential, developmental level, physical attributes, effective development, and motivation—and how they learn, which will promote the spirit of scientific enquiry and experimentation(Hofstein and Lunetta, 2004). Therefore for an individual to be deemed to be 'competent' under the Regulations, he or she must have 'sufficient training and experience or knowledge and other qualities' pertaining to the subject matter to be able to undertake the task. According to Abrahams and Millar(2008) cite that the nature of the activity is possibly the most important matter to consider a teacher has to portray a sense of responsibility in the manner the teaching is being executed specifically in teaching practical lessons. The instructional techniques must stress development of thinking skills as well as acquisition of science information. For example Integrating Science and Mathematics Teaching. As learners pose and solve science problems, they will naturally require use of mathematics, so combining instruction in both subjects, along with English language skills development, reinforces learning of each. It is especially important for learners to use mathematics to answer questions arising from their classwork; solving math problems they themselves have created will help them better appreciate math's practical usefulness. Further, integration of science, mathematics, and English language learning averts the need for the common and fragmented English as a Second Language or remedial math "pull-out" instruction that is less effective and stigmatizing for learners. Science instruction is most effective when the content is organized around common themes. The themes can be broad science concepts such as the nature of matter or magnetic energy; or they can be societal issues such as the pollution and purification of water or the impact of drugs on the physiology and behaviour of living organisms. This approach puts scientific knowledge in a comprehensible context with relevance to students' lives, which increases the probability that learners will continue to want to learn science and language on their own; extends the time over which a single topic is studied, allowing more time for understanding and reflection, and for repetition in the use of the English vocabulary; and reduces the propensity to overcrowd the curriculum with complex content and vocabulary. Research has shown that mode of instruction in the delivery of the subject matter in science has a great bearing on the acquisitions of concepts put across to the learners.

The world over, and Zambia, in particular, it is revealed that teachers are faced with a number of challenges in lesson delivery. Educating Our Future (1996) stresses that Basic education lays a foundation on which all further education must build. This implies that we must re-focus on our way of looking at the teachers in terms of teaching science at both primary and secondary sectors if they have to contribute effectively to the well-being of a learner. Based on the studyScott, (2010) ascertains that pedagogical content knowledge is the knowledge teachers have about learners and how they learn in a given context. In generalizing from Brophy’s work we have to be careful that it is drawn from studies in countries where teachers have generally had several years of postsecondary education and so have some met some essential minimum standards of science subject knowledge. However, in countries where teachers have had less science education of teachers need support for them to deliver effectively. They need to be trained for them to be equal of the task and this is cardinal at any level of teaching. They will further be relevant in all cases where they are providing internal cover or on supply and may not be specialists in the subject being taught. Based on the study Scot (2010) argues that if there are any doubts about the ability and experience of teachers supervising a practical lesson in any subject, they should not be doing it at all. The researcher is of the same opinion because teachers are the key players in improving the learning of all our children in school. The large majority of the world’s population have experience of being in school and the job of the teacher may seem obvious. However, detailed studies show the complexity of the role of the teacher, especially where the teacher is responsible for the majority or the entire curriculum. Longer-term studies show that to change the fundamental practice takes time. To change classrooms to focus on learner learning, as a quality science education demands, is no small task and will require the willing cooperation of teachers, parents, local, regional and national authorities, as well as the learners, who will experience a different schooling. This calls for collaboration among all the stakeholders for the teachers to be instrumental in the process of teaching specifically practical lessons in science. Scot (2010) from the study stresses that if not, there is a danger of pupils seeing practical work merely as a break from the more routine activities of speaking, listening and writing. However, any particular piece of work should have its purposes made explicit to pupils if they are to benefit fully from it. The activities chosen should portray range of purposes and highlight different types of practical activity that could be used to teach various topics in the science curriculum. Mzumara (2008) cautions that supervision would be encouraged by Heads of Science Departments to look at what is being offered in terms of practical work within their own institutions and ensure that the full range of purposes are covered. It is argued in this study that if the above areas are evaluated using the proper evaluation instruments, the results will act as a guideline, directing teachers as they strive towards quality teaching and learning through that use mobile laboratory.

Research further is concerned with more effective instructional strategies for curricula based on themes calls for hands-on experience in a cooperative learning environment. In addition, multiple references are needed, rather than a single textbook, so learners Students are given material to stimulate their thinking and prompt scientific questioning. These questions lead to hypotheses for testing, leading to student learning science concepts and developing their learn the value of investigating and comparing a variety of sources in order to learn, and are exposed to many types of writing and a larger English vocabulary. The lack of relevance of the S&T [science and technology] curriculum is probably one of the greatest barriers for good learning as well as for interest in the subject. The outcome of the project will be empirical findings and theoretical perspectives that can provide a base for informed discussions on how to improve curricula and enhance the interest in Science and Technology in a way that respects cultural diversity and gender equity promotes personal and social relevance empowers the learner for democratic participation and citizenship. Researchers (Gall, Gall, & Borg, 2007) posit that education in science serves three purposes. First, it prepares learners to study science at higher levels of education. Second, it prepares students to enter the workforce, pursue occupations, and take up careers. Third, it prepares them to become more scientifically literate citizens. The relative priority and alignment of these three purposes varies extensively across countries and cultures. Regardless of the setting, a sound education in science emphasizes that science is both a way of knowing and a body of knowledge; it also emphasize integrating scientific inquiry with scientific knowledge. Teachers need to be competent in their area of specialisation specifically the teaching of practical lessons. These sectors should have well-qualified teachers competent enough to handle the learners efficiently. The Ministry of Education (1992) recognises teachers as being one of the chief determinants of educational effectiveness in that they are the ones who shape children's intellectual formation and promote their desire and ability to learn. The Ministry of Education goes on to say that as such, teachers should be proficient in the subjects they teach by continuing to be learners themselves, advancing in the knowledge of their subjects and improving their teaching skills. This entails that advancing knowledge would be done through Continuing Professional Development (CPD).

From the same perspectives, the government has put in place a system that integrates and unifies Primary, Secondary and Higher level of education. This is to enhance the skills and competencies acquired by teachers to enable them to handle the learners with confidence. Kelly (2002), ascertains that with these changes made in the education sector, it calls for improvement in the quality of teachers for the provision of adequate facilities and support services. This, in turn, called for initiatives and programmes which would impact heavily on the teaching and learning processes in schools. The teacher input, in this case, will be through preparation and delivery of effective lessons emanated from teacher's resourcefulness, which is derived from the training that teachers undergo, both in-service teacher education and continuing professional development'(Ministry of Education, 2007). In other words, the ultimate aim of all in-service and continuing professional development is the improvement of learners learning through the development of teachers as reflective, autonomous professionals who have not only developed a range of skills but also a broad knowledge of understanding of the subject content and of the conceptual framework of teaching and learning.

Some studies conducted on the enhancement of teacher competencies confirmed that continued professional development for a teacher is a necessity for a teacher to attain competence.

Many studies have stressed the importance of training for a teacher. This is confirmed by Mwanakatwe (2009) who supports the fact that a teacher is not a product of chance and that initial training, in- service education and continuing professional development underpin what the teacher can accomplish in school. All teachers of science have implicit and explicit beliefs about science, learning, and teaching. They can be effective guides for learners learning science only if they have the opportunity to examine their own capabilities in terms of their professional developments as well as the understanding of the beliefs on which the concepts are based. Belington (2007) posits that both teachers and learners can drive and make an informed decision on the methodology which can evidently change the status of learners. The teachers need to adjust the instructional procedure whereas learners have to regulate their learning tactics to effectively accommodate the concepts put across them. Additionally teachers need to be conversant with the method being applied to teach so as to get the required feedback from the learner. The information from the observations and questions to learners is used by the teacher to identify the changes which can be applied to improve the learning. In the context of the mobile laboratories, there are a number of strategies used, for example, group work, activity based and other learning tasks which can elicit evidence of learner understanding. The learners should be activated to become owners of their learning and in the long course building the capacity to become responsible recipients of the process of learning. This is in line with motivation, interest, skill development and acquisition of knowledge (Scott, 2010). The use of mobile laboratories to teach science is in line with collaborative teaching which a powerful tool to move learning forward in terms of competence build up. Suttan *et al*., (2008) point out that the use of mobile laboratories improves teaching and learning and both learners and teachers possess competencies and skills which can be applied later in their lives. They further postulate that to use practical lessons teachers must change both the way they view such lessons and how they interpret learners behaviour because their demonstrations will have facilitated learning or hinder its progress. This demands that mobile laboratories need to be considered as an integral part of learning and as an essential element in an effort to help learners learn effectively.

This entails that when teachers access a variety of reading and reference materials, their lessons are enriched and subsequently learners benefit through improved learning outcomes. In addition, Ndopu (2010 M.Ed. Thesis unpublished), points out that researchers have supported findings that ‘the academic and professional training of teachers has a direct and positive bearing on the quality of their performance and consequently on the achievement of learners. The development of complex skills, which is important by itself, is crucial for the learning of complex scientific knowledge. The type of practical work selected by teachers should correlate with the level of the learners. This can only be attained by a teacher who is sound with the content matter of a subject (Millar, 2010). The laboratory activities are mostly illustrative and the learners do not have the opportunity to carry out activities with a real investigative character. It is therefore recommended that when teaching any topic, the teacher has to be aware of the fact that learners are unique and they as a result understand differently. This then requires teachers to vary teaching and learning strategies to try and accommodate all learners. Therefore, there is a need for continuing professional development so as to improve input of personnel and the product, in this case, the teacher and the learner respectively. Lunetta, Hofstein and Clough (2007), evidently also noted that while learners are engaged in learning about the natural world and the scientific principles needed to understand it, teachers are working with their colleagues to expand their knowledge about science teaching.

Every competent teacher has to conversant with the materials inclusive the learner to whom the teaching is applicable. Some studies argue that a teacher makes innumerable judgments of quality for which he cannot state rules and procedures. Even when he makes conscious use of research-based theories and techniques, he is dependent on tacit recognition's, judgments, and skilful performances. The researcher is with the same view because when teaching practical lessons in science instructions must be concerned with the experiences and context that will make the learner willing and able to learn and must be structured in manner which will make the learner to easily grasp them. Therefore this calls for a teacher who is knowledgeable in the subject matter as observed by (Scott, 2010) when learners were assessed on tasks which they worked on without help, they did not perform well. The researcher can draw the assumption that it is only the teacher who is not knowledgeable who can deny to offer the help which learners deserve. The engagement with the teacher avails learners an opportunity to refine their thinking and as a result help learners to perform better. This is necessarily because the teacher is teaching the learners all the time. Aikenhead, (2005) conquers that learners have to construct their own meaning regardless of how clearly teachers or books tell them things. Mostly, a person does this by connecting new information and concepts to what he or she already believes. Concepts are essential units of human thought that do not have multiple links with how a learner thinks about the world are not likely to be remembered or useful. The researcher is with the opinion that concepts are learned best when they are encountered in a variety of contexts and expressed in a variety of ways, for that ensures that there are more opportunities for them to become imbedded in a learner's knowledge. This implies that practical activities not only enhances skill development but avails the learner an opportunity to explore new avenues of acquiring knowledge (Aikenhead, 2005).Learners can learn most readily about things that are tangible and directly accessible to their senses—visual, auditory, tactile, and kinaesthetic Gilbert, (2006).With experience, they grow in their ability to understand abstract concepts, manipulate symbols, reason logically, and generalize. These skills develop slowly, however, and the dependence of most people on concrete examples of new ideas persists throughout life. This confirms that concrete experiences are most effective in learning when they occur in the context of some relevant conceptual structure. The difficulties many learners have in grasping abstractions are often masked by their ability to remember and recite technical terms that they do not understand. Scott (2010) study cites that a competent teacher is concerned with the feedback from the learners. Gilbert (2006) stresses that effective learning by learner requires feedback. This entails that the mere repetition of tasks by learners whether manual or intellectual is unlikely to lead to improved skills or keener insights. Learning often takes place best when learners have opportunities to express ideas and get feedback from their peers. Scott (2010) echoes that for feedback to be most helpful to learners, it must consist of more than the provision of correct answers. Feedback ought to be analytical, to be suggestive, and to come at a time when learners are interested in it. Practical in science when being carried out y competent teacher must reflect the altitude in classroom so that learners adjust in accordance to the feedback the teacher takes into account Learners must be accorded time to reflect on the feedback they receive, to make adjustments and to try again a requirement that is neglected. However, it is worth compelling as evidence of understanding. Scott (2010) claims that learners respond to their own expectations of what they can and cannot learn. The researcher views that if they believe they are able to learn something in whatever context they usually make headway. However, if they lack confidence, learning eludes them. Gilbert (2006) posits that learners grow in self-confidence as they experience success in learning, just as they lose confidence in the face of repeated failure. Thus, teachers need to provide them with challenging but attainable learning tasks and help them succeed. In terms of practical lessons in science the teacher should be conversant in the setup of experiments, demonstrations as well as involvement of learners so that learners are able to draw the zeal from the teacher's exposition.

Scott (2010) echoes that what is more, learners are quick to pick up the expectations of success or failure that others have for them. The positive and negative expectations shown by parents, peers, teachers and generally by the news media affect learners' expectations and hence their learning behaviour. A number of studies indicate that when, for instance, a teacher signals his or her lack of confidence in the ability of learners to understand certain subjects, and the learners may lose confidence in their ability and may perform more poorly than they otherwise might. This applies to science especially practical lessons teachers should engage the learners actively. Based on research it is claimed that sound teaching usually begins with questions and phenomena that are interesting and familiar to learners, not with abstractions or phenomena outside their range of perception, understanding, or knowledge. They need to get acquainted with the things around them including devices, organisms, materials, shapes, and numbers and to observe them, collect them, handle them, describe them, become puzzled by them, ask questions about them, argue about them, and then to try to find answers to their questions (Gilbert, 2006). Therefore, science teachers should emphasize clear expression, because the role of evidence and the unambiguous replication of evidence cannot be understood without some struggle to express one's own procedures, findings, and ideas rigorously, and to decode the accounts of others. The researcher is with the view that the teacher should avail enough room to the learners to enable them to explore freely without having the fear of making mistakes. Aikenhead (2005) echoes that in science, conclusions and the methods that lead to them are tightly coupled. Gilbert (2006) postulate that the nature of inquiry depends on what is being investigated, and what is learned depends on the methods used. Science teaching that attempts solely to impart to students the accumulated knowledge of a field leads to very little understanding and certainly not to the development of intellectual independence and facility. The researcher is with the view that to teach scientific reasoning science teachers should help students to acquire both scientific knowledge of the world and scientific habits of mind at the same time. In learning science, learners should encounter such values as part of their experience, not as empty claims (Aikenhead, 2005). Teachers should demonstration the practical lessons so that the learner gets engaged in the activities as hands-on laboratory experiments are most effective in learning scientific concepts. Teachers should refrain from demonstrations that leaves many of the learners to be just observers or not even able to see what is being demonstrated depending on the number of them in the class. This approach does not make learners achieve a functional understanding of the scientific concept since it does not fully involve learners in learning (Gilbert, 2000).

On the other hand a competent teacher has to take into account the availability of laboratory resources. Ryan (2203) posits that lack of laboratory resources hinders teachers from effectively engaging their learners with science experiments. Most of the studies in the field of science education indicate that the availability of laboratory equipment in teaching and learning science has been given central role, since it motivates effective teaching and learning process. Likewise, according to FEMSA (2010) as cited in UNESCO (2010) it has been observed that in teaching and learning science the teachers' motivation and retention drops due to the inadequate infrastructure such as equipment and laboratory. In the context of

Zambian secondary schools, the availability of laboratory resources varies from one school to another, which results in inequalities of learning outcomes, especially in science and mathematics subjects in which students in primary schools consistently perform poorly Zambia Examination Council (2010). This poses a challenge in Zambian schools which has already alluded to made the government to embark on Mobile labs to help facilitator the teaching and learning of science in schools. Hence,   research studies in many countries have found that there is positive correlation between availability of resources and students performance (Lemke, 2012). For that reason, teachers and learners in most primary schools are disadvantaged in that they do not have adequate learning facilities including laboratory and equipment besides having overcrowded classes. Thus, teaching and learning science becomes challenging since teachers find it difficult to involve students in hands-on activities and as a result decide to use teacher-centred approach. This results in many learners losing hope of studying science and opt to study art subjects (Scott, 2010). Consequently, there is a need for educational stake holders including the Ministry of General Education and the community at large to understand teachers' experiences so that they could find strategies to help teachers teach science more effectively in ways that could motivate learners to learn.

Similarly, many studies have reported that laboratory activities in Zambian primary schools in particular are insufficient and ineffective. There are several reasons for the ineffectiveness of laboratory activities such as the shortage of science teachers (Mzumara 2008) teachers' low competence in laboratory experiments since they themselves learnt science through alterative to practical during their schooling (Mzumara, 2008); lack or limited laboratory equipment (Gilbert, 2006) and overcrowded class size (FEMSA, 2010).Therefore, considering the current nature of learning environment in most primary schools where there is inadequate laboratory equipment, this study focuses on exploring science teachers' experiences of teaching science in schools using mobile labs as an alternative.

Teacher's competence is as well reflected in his/ her perceptions which influence how teaching and learning takes place (Millar, 2000). In teaching and learning science, Mzumara (2008); Millar (2000) and Lunetta, Hofstein and Clough (2007) studies reveal that teachers have positive perceptions about laboratory activities since they contend that it leads to students' engagement and active participation in the learning process. Moreover, since science is an experimental discipline, laboratory become an important place essential in developing learners' scientific processing skills and logical thinking (Clark, 2000; Hofstein and Clough

(2007); SCORE,(2008).Taking into account the role that hands-on activities play in the teaching and learning of science, the Zambian science curriculum indicates that teaching and learning strategies in science should be student-centred and activities oriented Curriculum Framework (2013). Nevertheless, instructions from the science curriculum and the known benefits, it remains a fact that the teacher is the key player in curriculum implementation (Hofstein and Clough, 2007). Therefore the teaching and learning of science with limited laboratory resources can be shaped by teachers' perception. The researcher is with the view that the focus of the teacher must be focused on the learner whose transformation is anchored on the teachers' effort in the process of teaching the practical lessons in science.

Teachers' experiences and perceptions both affect their classroom practices. For instance, Millar (2000) assert that teachers' own experiences together with their perceptions of how science is taught may determine the strategies that they use to motivate students in learning science. Thus in teaching and learning science with limited resources a teacher may try to find appropriate ways of ensuring that students understand the subject matter despite the inadequate equipment. However, if teachers perceive that laboratory equipment are important in teaching and learning science but getting the resources is beyond their control then they may abandon or distort central ideas of teaching science Lunetta, Hofstein and Clough (2007) . Therefore, in teaching and learning science with limited laboratory equipment, the teachers' views about teaching science as well as their experiences should be considered(Gilbert, 2006).

Most science teachers perceive that laboratory activities are essential in teaching science as it stimulates students' interest as well as developing their scientific skills (Lunetta, Hofstein and Clough).Additionally, it reveals that teaching practices are part of complex processes defining teachers' classroom experience which include the delivery of the content, students' involvement, student-student interactions and student-teacher interactions to e paramount in the teaching process. In a large scale study conducted in American public schools reveals that many science teachers perceived that hands-on activities is the best strategy for effective science teaching and learning (National Research Council, 2007). However this is only possible under manageable class sizes and adequate facilities and resources (Mzumara, 2008). In addition, literature on science education has revealed that teachers' views and perception of science are often considered an important factor that frames their instruction practice (Hofstein and Lunetta, 2004). Therefore, when teachers have naive perception of teaching science with limited resources, they may fail to be innovative in giving students opportunities to make meanings through laboratory activities. Consequently, in teaching and learning science, teachers could use other innovative ways to teach science when there are inadequate laboratory resources so as to make the lesson effective. These innovative ways include teaching science using locally available resources and through demonstration.

In the quest to enhance teacher competencies, the Ministry of Education, Science, Vocational Training and Early Education has constructed a number of resource centres in the country. A resource centre is a term used to describe a type of library that exists within the zone (where a group of teachers meet) for continuing professional meetings. These centres contain resources such as books, journals, software and audio/video materials for learners and teachers to use (Alomran, 2007). Resource centres are run by zone, district or provincial coordinators in order to provide access to quality and timely resources to teachers. A key aspect of a resource centre is the applications of self-study in a variety of different ways. This model provides a valuable learning experience through teacher interactions and the supporting activities that assist in exploring career interest. Many studies have revealed that the expansion of facilities for training teachers to have access to education boosts their intellectual stimuli which influence their perceptions of themselves in line with handling learners. It is revealed that the higher self-esteem of a teacher is translated into higher personal confidence due to the fact that his or her values, interests and skills in combination with certain personality traits may make a teacher sustain the professionalism. This is unexceptional of teachers for Integrated Science as they are also expected to use the resource centres to enhance their skills in teaching Integrated Science.

2.4 Teaching of Practical Lessons to Students

Based on evidence from Score Report the importance of practical work in science is widely accepted and it is acknowledged that good quality practical work promotes the engagement and interest of students as well as developing a range of skills, science knowledge and conceptual understanding. It is also acknowledged that in the UK more practical work takes place in science lessons than most other countries. However concerns have been expressed by section of the science community, industry and business that schools in general are not doing enough practical work and that its quality is uneven. This report into practical work in science in the UK during 5-19 education reviews evidence and, based on its key findings, proposes a strategic framework for enhancement of the practical work in science in schools and colleges.

Various research findings affirm that the more traditional way of teaching science is the lecture/discussion method, where teachers tell the learners what they are to learn, and then ask them to answer questions about what they heard, frequently providing the answers themselves if learners don't respond quickly enough. Hofstein and Clough (2007), argues that this approach limits the learning experience for all learners, for it gives them very little opportunity to discuss issues, solve problems, or ask their own questions, and, thus, to develop thinking skills. It is even less effective for learners since it is more dependent on learners understanding of what the teacher says, and it provides few occasions for them to speak, and, thus, practice their communication skills. Teachers' expectations of how much and how well their learners will learn directly influence that learning. Teachers are expected to set high learning expectations for all learners and encourage them to set high expectations for their own learning. Study by Ryan (2003) postulates that teachers express their expectations for and beliefs about their learners through both their nonverbal and verbal behaviours. Learners who are believed to be high-ability learners receive more positive nonverbal feedback from teachers such as smiling and eye contact. The teachers' aims at supporting such learners to develop such learning will required to stimulate a learner and elicit change in the way many teacher would go about their work (Hofstein and Clough (2007). However, learners believed to be low ability ones are asked fewer and less challenging questions; they also get less feedback, less time to respond, and less praise. When instruction is tracked, perceived low-ability learners often receive less challenging content and are given more assignments that require rote memorization and drill-and-practice activities. Teachers' overly high expectations for high-ability learners, however, can lead to inaction when those learners do need corrective action in order to achieve. National Research Council (2007), cites that learners are sensitive to teachers' beliefs about them. In cultures where low achievement is attributed to low ability and ability is believed to be unalterable, low-ability learners often come to believe that their performance will not change regardless of their level of effort. In cultures where learners' level of work and effort is considered directly related to their learning, high expectations for all learners lead to higher achievement through more work and effort by learners of all abilities. The researcher opinion strives to bridge the gap on the in the position of presenting science to the learners and Research findings have reported that laboratory experiences have been purported to promote central science education goals including the enhancement of students' understanding of concepts in science and its applications; scientific practical skills and problem-solving abilities; scientific 'habits of mind'; understanding of how science and scientists work; and interest and motivation. Anderson (2007) cites that Practical work lies at the heart of primary science. Children need opportunities to develop practical and enquiry skills in order to engage with the world in a scientific way and to make sense of what they are learning about living things, the environment, materials and physical processes. Hands-on experience promotes curiosity and engagement and provides opportunities for the discussion and questioning which develop understanding. Practical work can take place inside or outside the classroom, and can happen at any point in a unit of work or lesson. It may be a five minute demonstration, a short activity to practise using an unfamiliar piece of equipment or an extended enquiry. What it must be is a varied and integral part of the learning process which promotes thinking as well as doing (Anderson, 2007). Students come to understand how living things behave through opportunities to engage in practical activities. From research Biology involves making sense of complex systems at the level of cells, organisms and whole ecosystems. Often biologists have to devise models that isolate individual processes for closer study, have to control the many variables in a system to see the effect of each more clearly, or have to study changes over long time scales. The researcher's view brings to light that a successful biologist will master key ideas in chemistry and physics, and use mathematical tools for interpreting and analysing data. Much of what learners learn in biology is directly applicable to their own lives, as a growing understanding of other living things help them to learn about the human body and the wider environment. Teachers need to embrace and accept some measure of responsibility for their learners' struggles and failure to learn. The degree of responsibility they accept depends on the students' level of effort to learn. If learners and teacher both work hard, the teacher should accept a large portion of responsibility when learners encounter difficulties or fail to learn. The teacher should also be able to modify instruction to help struggling and failing learners improve (National Research Council, 2007).

The uniqueness of the laboratory as a medium for learning and teaching science has caused it to be the subject of many research studies and several reviews since the 1960s. The reviews include a number of researchers' publications inclusive Hofstein and Lunetta (2004) to mention a few. These reviews of research on the school laboratory reveal comparison of schools that taught science lessons using the mobile science laboratories (MSL) with schools that did not use the MSL showed that children find science more interesting when they are able to do experiments themselves(Hofstein and Lunetta, 2004). This research on learning brought forth knowledge of learners' development and new insights about the learning of science concepts. Typically, laboratory learning has meant experiences in school settings where learners interact with materials to observe and understand the natural world. Some laboratory activities have been designed and conducted to engage students individually while others have sought to engage learners in small groups and in large-group demonstration settings. Teacher guidance and instructions have ranged from highly structured and teacher-centred to open inquiry. The terms have sometimes been used to include investigations or projects that are pursued for several weeks, sometimes outside the school, while on other occasions they have referred to experiences lasting twenty minutes or less. On the other hand laboratory activities have incorporated a high level of instrumentation and at other times the use of any instrumentation has been methodically avoided.

Teachers' vigilance means that practical activities in schools are vital and play a magnificent role in the learning process. Nevertheless, teachers concerned about situations with which they are asked to cope when undertaking practical activities with pupils. Studies by Anderson, (2007) ascertains out learning is a purposeful, internal, mental process. Teachers can monitor learning by observing and gathering data on changes in learners' actual behaviour or potential performance. Practical lessons should motivate and engage learners in the process of starting and continuing learning without learners encountering difficulties or failing to grasp the concepts (Anderson, 2007). There should be relevance in the activities that give learners satisfaction and meet their needs, including the chance to achieve personal learning goals. In order to capture learners' attention and activate their motivation to learn, teachers must consider the relevance of each topic. Then they can connect science with students' interests, personal lives, societal issues, cultural backgrounds, and other school subjects. Cognitive learning theory emphasizes the importance of learning something new by relating it to things that are already meaningful and familiar. Science teachers must remember that their own intrinsic motivation to learn science practically is likely not shared by many of their learner, whose motivation is more likely activated instrumentally, by connecting science to things that are already familiar and important to them.

Anderson (2007) from the study postulates that teachers have a responsibility to present practical lessons to their learners to enhance stimulation of children's intellectual development, schools need to acquire a surer feel for contemporary cultural conditions. Teachers as professionals in school must become familiar with the diverse ethnic and cultural backgrounds of their learners in order to draw on these differences to make instruction more meaningful and relevant. Anderson (2007) further brings to light that teachers have long taught science as a sequence of lectures and reading assignments on its body of knowledge. If laboratory activities are included, they focus only on the development of lab skills and techniques, not on constructing new scientific ideas through inquiry.

Research has shown that today's learners live in a world full of the products of scientific inquiry and engineering development. When learners complete their formal schooling, they are expected to enter a world filled with products that do not exist today—products that will be the result of scientific inquiry and engineering development. Today's learners must learn how to do scientific inquiry and use scientific information to make decisions that will affect their personal lives, careers, and societies (National Research Council, 2007).

To prepare learners to live and work in tomorrow's world, science teachers must make room for scientific inquiry by decreasing their emphasis on teaching science as a sequence of lectures and reading assignments on the body of scientific knowledge. In addition, teachers must greatly decrease their coverage of non-core scientific knowledge. While doing so, they must retain the core knowledge in the scientific disciplines and increase their emphasis on scientific inquiry as a core part of science content and as a method of instruction. Other Authors echoers that learners should also be given ample opportunities to test their own ideas. And this can be attained by ideally, teachers should providing a variety of resources to support learners ' discovery activities: materials for science laboratory investigations; reference books, newspapers and magazines, and access to libraries for additional materials; classroom visits from specialists in the community; field trips; films; and computer programs.

What this implies is that if quality teaching and learning are to be achieved, a process to ensure the basic functionality of a school is put in place. In order to ensure that a school functions as required, a number of areas that are critical to its basic functionality have to be properly organised (National Research Council, 2007).

Many authors have identified the strategies for improving the effectiveness of practical work. Millar (2010) states that learners need to think as well as act and goes on to point out that effective tasks are those where students are not only *'hands on'* but also *'minds on'*. In Millar's opinion, improving the quality of practical activities requires first that teachers become more aware that making links between the domain of objects and observables and the domain of ideas is demanding, and then helping them to design practical tasks which take this demand more explicitly and fully into account – tasks which 'scaffold' learners' efforts to make these links. This, in turn, requires that teachers analyse more carefully the objectives of the practical tasks they undertake, and become more aware of the cognitive challenge for their learners (Alomran, 2007). The starting point for improving practical work is, therefore, to help teachers become much clearer than many are at present about the learning objectives of the practical tasks they use. This entails that learners' active participation and cooperation with their teachers will contribute to their active involvement in the learning process.

In another study Millar (2010) postulates that learning of science through practicals offers students the opportunity to get involved in experimental “hands-on” activities conducted by the learners themselves. This exposes them to real world experience which makes the learning process fun and interesting. Laboratory activities result in improved learners’ attitudes toward learning in general and towards acquiring certain skills from the laboratory, in particular. They get a chance to experience the context in which teaching and learning of science can provide the empirical basis of what could be done to counter the contributory factors to poor performance in this subject. This is evidenced throughout the world where the mobile laboratories play an integral role as an innovative new way to reach a large number of students with high-quality science education. For example, in the United States of America (USA) the mobile laboratory consists of a van carrying everything needed to rapidly set up a teaching laboratory at any school. It contains standard laboratory equipment for a range of experiments and demonstrations which can be shown to the class at the start and end of the session. Additionally, the need for a stronger migration towards science, technology, engineering and math (STEM) education is paramount as it is estimated that the U.S.A. will have more than 1.2 million job openings in STEM-related fields by 2018. According to the U.S. Department of Labour, there will be a significant shortage of qualified college graduates to fill these jobs (Accessed from www. aplusterlaboratory.com). This necessitated the establishment of A+ STEM L in 2002, as a division of A+ Technology Solutions whose idea was to create a portable technology and science cart that could be moved from room to room and was a fraction of the cost of renovating an entire classroom and dedicating it to science. To date, there are more than 500 mobile laboratories integrated into the New York City school system. The learner in this context will not only acquire the knowledge but is accorded the chance for a hands-on process which assists them in thinking abstractly and this aspect is very important in the learning of sciences specifically the practical aspect. Without abstract thinking, scientific concepts have to be explained in clear consistent terms using concrete objects. This is highly supported by Bell (2011) who argues that concrete objects conceptualise the learning process of a child. This skill is important in learning science because science calls for exploring and discovering.

In the study that looked at mobile laboratories, Clark (2009), posits that the key advantage of a mobile science laboratory is that one set of equipment can be used to serve multiple schools. Learners do hands-on experiments which provide added educational value to the subject and provide inclusive teachers with access to equipment and supplies that are difficult for most schools to acquire and maintain. The picture is the same, for example, in Uganda where a mobile laboratory visits schools providing practical science experience to students to enhance learning. It does a circuit of eleven schools, reaching each one every three weeks and delivering a set of action-packed practical lessons. It also travels with a number of trained teaching staff who are experienced at getting students stuck into science, and helping them through any problems they encounter. This allows them to have staff: student ratios that support effective learning. Hench *et al.,* (2008) emphasise that the teacher must provide an opportunity for learners to complete their work and learn effectively. If a practical lesson has to be effective, the teacher needs to plan and prepare in terms of the good learning environment for the students and work in collaboration with the students to make the learning meaningful. Another outstanding example is in Mpumalanga one of the South African provinces faced with enormous challenges in the persistent poor performance in Science subjects among pupils due to lack of laboratories. Tsipa *et al.,* (2010) articulate in their research on the impact of mobile science laboratories in the performance of Grade twelve learners in the Mpumalanga Province that pupils learn more efficiently when exposed to a conducive environment and in this context is the access to the Laboratory as a facility for proper learning. This recent literature reaffirms the positive role of experimentation in increasing students' active and vital participation in the learning process, it as well helps students to acquire different skills and form positive attitudes towards science learning (ICSU, 2011). By seeing educators demonstrating experiments themselves, learners supplement what is in textbooks and as a result learning is enhanced.

In the survey conducted by Curriculum Development Centre (2010) it was found that in Zambia, the ability to think scientifically and understand scientific processes is becoming a condition for survival. As a result, the national policy emphasises the need for learners to develop skills that they can apply in their environment. Therefore, the prime goal of science teaching is producing a learner who can be able to apply his/her own ideas, use his/ her own hands, own investigations and this was necessitated by the use of laboratories in schools. The learner should be exposed to all teaching and learning activities in the sciences in which the student is actively involved and that allow the mobilisation of science processes skills and scientific knowledge and that may be materialised by paper and pencil activities or observing and/or manipulating materials (Hench *et al.,* 2008). To be attainable, the teacher is expected to have the sound subject knowledge, make reference to a number of resource materials and consult an expert in the areas of doubt. However, currently in Zambia, the challenge is that most primary and secondary schools do not have conventional science laboratories to support practical aspects of science teaching and learning; this is reaffirmed in an address by the National Science Centre, with financial assistance from JICA and Ireland through the education sector pool fund during the launch of 1,010 mobile science laboratory kits in 2013(*see Appendix I*). Consequently, such a gesture sparks the interest of learners, in learning science because particular concepts will be implicit and more group work may be merged into the classroom (Masiye, 2013).

As evidenced by a number of researchers' practical work includes any activity that requires learners to be active and mobilises scientific skills. On the other hand, it must be re-echoed at this juncture that like Muzumara (2008) also evidently argues that science is a subject with the practical importance which pupils can learn in order to kindle an interest in them and develop a positive scientific attitude in the environment which equips them with lifelong skills. And this is in line with the concept of the National Science Centre to produce a learner who is not only theory based but a learner who if given an opportunity to manipulate practical skills can apply scientific principles in life. For this to be attainable, the background of the learner is very important, the teacher needs to know whether the learner has scientific and technology outlook which is essential in understanding some of the basic scientific and technological activities in our daily living. This is postulated by Muzumara (2008) when he states that, '…the child comes from a background that is rich in modern technology so that the science lesson he/she receives help to cement understanding of the operation of some of the modern machinery and appliances found in homes. Additionally, practical skills play an important role in the acquisition of academic and social skills. Therefore, learning science theoretically poses a very big danger as the learner is denied the hand on a practical aspect which negatively affects the learning of science and the teachers' skills at teaching such a pupil are put to the test (Abruscato, 2009).

Many research studies have pointed out that science is one practical subject that demands a lot of resources. These are in terms of stationary and laboratory equipment's (Belington, 2012). The biggest challenges for teachers and schools are obtaining these science materials for a meaningful lesson. For instance, a science laboratory has to be equipped with all the equipment so that learning becomes meaningful to a learner. The unavailability of these materials in the school makes learning difficult for learners. Therefore, the learner is curtailed from the information that could be evident through direct observation of the natural phenomenon. This hinders the integration of the curriculum and the experiments for them. In addition, common concepts are not emphasised or applied from one science to another, so that the learner can get a more holistic picture of the different disciplines that they are studying.

The study further observed that when the classrooms are more crowded learners seem not to receive enough attention. Abruscato (2009) from the study establishes a number of challenges regarding overcrowding in a classroom. The survey by FEMSA (2010) claims that inattention can result in unruly classrooms. For example it becomes extremely difficult to carry out a demonstration to a big class as control of the class is impossible. Therefore, the teacher is glued to the front of the classroom and it becomes near impossible to go round either to mark work or assist the individual learners. This results in teachers being forced to use lecture method all the time because of the rigidity in the seating arrangement. Millar (2010) ascertains that the classrooms which are more crowded learners did not seem to receive enough attention. They have increased the possibilities for at-risk learners, as well as others, to lose interest in school and do poorly on tests. Research shows that these learners do not getting individual attention, have low reading scores, are frustrated and stress is felt by the teachers, and the inability of learner to concentrate or stay on task while in class. The first problem identified was that teachers are unable to give individual attention to the students. Teacher's aides are not always available and sometimes learners have to share textbooks. It can take the entire class time for learners to find seats, make sure everyone has a textbook to look at and then explain the next assignment. This leaves no time for individual attention off the groups to explain clearly the instructions how to go about with the practical. Secondly the teacher becomes frustrated to handle a very big class which results into stress that the teaching staff experiences in trying to teach learners in crowded classrooms with no time to devote to learners as individuals who need extra help or to offer enrichment tasks to high achievers. Often this frustration gets passed onto the learners who in turn feel the stress, resulting in being bored (Millar(2010).Additionally, learners may experience low reading test scores. Abruscato (2009) cites that with teachers unable to help individual learners , those who need extra help in acquiring the necessary skills on how to set up an experiment, interpret data and at times how to plot the graphs ,gaining or maintaining their reading skills get left behind. They are unable to keep up the reading or in class discussions which they are expected to initiate becomes a challenge to the learners. Abrusto (2009) from the study stresses that oovercrowded classroom often do not have enough space for supplementary equipment for example a classroom might have to forgo other activities which other learners are doing. Students who have seated close to one another in the a classroom might have difficulty focusing on the lesson which leads to less learning and lower test scores the invasion of personal space and the feeling of being crowed both contribute to lack of focus . In addition learners can be distracted by noise that in close proximity to them in an overcrowded classroom.

Furthermore studies have shown that teaching in a small place is stressful for the teacher who has to adapt lesson plans to focus more on work that learners can complete. Abrusto (2009) echoers that practical lessons require more floor space for the teacher as well as the learners to manoeuvre freely. On the other hand, a teacher may not have enough personal office space for lesson preparation and meeting with learners who may need special attention. It is the researcher's opinion that when classes are overcrowded and laboratory space is limited, learners fail to benefit from classroom instructions. This is because the learner is deprived of attention to the human element of scientific activity and the task of construction of ideological and scientific creativity, the analysis which contributes to the development of scientific ideas. The learners need extra attention and support from teachers in order for them to grasp academic concepts. It is vital, therefore, that they are given extra time and individual attention away from the regular class in order for them to learn and progress in science. Therefore, overcrowded classes and limited laboratory space negatively affect the teaching and learning of science (Abruscato, 2009).The researcher is with the view that teaching a class which is overcrowded is not stressful to a teacher but put a learner in a negative situation for skill acquisition.

According to UNICEF (www.unicef.org/zambia/2016), education is a powerful driver of development and one of the strongest instruments for reducing poverty and improving health, gender equality, peace, and stability. Yet, even though there has been great progress in the last decade, some 121 million children are still out of primary and lower secondary school, and 250 million children cannot read or write. The children world over, specifically the developing nations, are not accorded such an opportunity due to poor funding from the government as well as cooperating partners. The lack of funding means that the much-needed materials will not be available thereby affecting science lessons for the learners. The Ministry of Education Annual Report for 2002 provides a picture of the performance of the Ministry for that year against our set national targets. The Ministry continued to be least funded in the sub region and from this, it can be claimed that the teaching of science can be affected negatively. Regular schools country wide struggle with funding to their science department and the situation is even worse when it comes to rural schools, (Kelly, 2008). Due to poor financial management, some donors decide to stop funding schools questioning whether or not the money is benefiting the intended parties (Belington, 2012). Many schools that depend on government funding are also negatively affected when government fails to fund them. There is well-documented evidence of the shortcomings of equipment funding and replacement of laboratories which require continued monitoring and should be addressed as part of wider strategy and improvement in facilities (Muzumara, 2008).

The study on societal influence confirms that society's attitude and perception on the learners is strong and pervasive. The impact of the negative attitude and discrimination on the child are the discouragement of independence and initiative, the limitation of adaptive skills, the development of feelings of inferiority. Chapman and Stone (2009) sadly point out that such stigma and discrimination sometimes comes from teachers who are supposed to be role models and thus contribute to the growth of these pupils. Teachers may undermine the academic potential learners especially the girl child to learn science subjects. Unfortunately, studies have confirmed the fact that when individuals are brought to form a negative opinion of them through the process of conditioning, it becomes difficult for those individuals to decondition themselves (Belington 2012). Hence some learners specifically girls believe that they cannot learn science. A large body of experimental research found that negative stereotype affects girls' performance and aspirations in science through a phenomenon called stereotype threat. Based on the latest available data from the UNESCO Institute for Statistics (UIS), there are 130 million girls not in school. Studies consistently bring to light that girls do not make decisions about their own lives and are farthest behind in terms of access to and completion of education. However, girls' education in science does not only benefit the individual. UNESCO (2010) echoes that Girls' education goes beyond getting girls into school. It is also about ensuring that girls learn and feel safe while in school; complete all levels of education with the skills and competencies to effectively compete in the laboratory market, learn the socio-emotional and life skills necessary to navigate and adapt to a changing world.

Other research findings, according to Millar (2010) revealed that the way class teachers present the subject has a great impact on the learner. The teaching process is not stimulating enough as teachers are not confident enough when handling practical lessons in science. This is highly supported by Lamanauskas (2007) who points out that the teacher has to know the subject matter which gives him the confidence to handle the learners. This is of great value as effective practical lessons enable learners to build a bridge between what they can see and handle and scientific ideas that account for their observations. For almost two hundred years, science educators have reported that laboratory activities can assist students in making sense of the natural world. Many have argued that science cannot be meaningful to learners without worthwhile practical experiences in the laboratory. Teachers tend to see teaching as "dominated by tasks and activities rather than conceptual structures and scientific reasoning." Hofstein and Lunetta (2004) reported that contemporary curricula did not engage students in laboratory activities consistent with goals for learning. Instead, the science visible in schools has focused on "covering" knowledge of science topics and limited problem-solving skills. Within that framework laboratory activities have engaged learners principally in following ritualistic procedures to verify conclusions previously presented by textbooks and teachers. In general, learners have had limited freedom and time to explore and to make sense of phenomena.

2.5 Academic Challenges Teachers Face in Teaching Science Practical Lessons Using the Mobile Laboratory in Integrated Science

The survey on teaching science effectively it was evident that it is difficult but rewarding work. The difficulty stems from two sources. First, students in most science classes bring a wide range of prior knowledge, experiences, reasoning, and interests. Second, teachers must integrate the core body of scientific knowledge and scientific inquiry in a way that does justice to both the aspects of science and their integration. Surveys revealed that serving teachers often hold science ideas that did not seem to be in line with the standard science as defined in the curriculum. Logically, it would seem that the more teachers know about the subjects they have to teach, the better it is for all concerned. (Belington, 2012) found that higher science background correlated with more subject-relevant interaction (effect size 0.73) and with more causal explanations (effect size 0.65) and these teacher behaviours may lead to better science learning. Basically, teachers' rewards are rooted in knowing that learners have learned as a result of their effectiveness as teachers. Belington, (2012) observes that teaching is a purposeful means to help learners learn and when learners work hard but fail to learn, the teacher must accept a large part of the responsibility. Teachers must embrace the view that effective teaching means constantly being aware of and attending to learners' struggles to learn science and continually adjusting their teaching strategies and techniques to help learners work through difficulties. In doing so, teachers should set high learning expectations, focus on core scientific ideas, and aim for deep, integrated understanding of scientific inquiry and the core body of scientific knowledge.

To help learners reach teachers' aims and expectations, teachers must understand how learners actively construct new knowledge, as well as the complexity of the learning process, the importance of learners' interests, and their potential anxieties and conflicts with science concepts. This means that the teacher needs to pay particular attention to special details in the way the lesson will be presented to capture the learners' interest. Millar (2010) points out that qquestioning is an integral part of teaching. In fact no teaching is complete without evaluation. It is through evaluation that the teacher determines whether the lesson outcomes have been achieved or not. Teachers questions are expected to spread thought out the class so that learners have an opportunity to participate in the evaluation. This avails the teacher the chance to plot those learners who are weak and those with the strength. Johnson (2010) postulates that during practical lessons learners evaluate their own activities since group work is being encouraged although teacher can embark on oral questions to enhance interaction with the class. Millar (2010) observes that all these have implications for curriculum development and implementation. The questions and answers should eventually lead to the new topic of the day. Bases on the studies the lesson activities should be tailored towards the materials and how well the learners will be involve in the lesson. Another reward for teachers is knowing that their learners are a sound education in science, one that prepares them for advanced studies and for their occupations and careers, and that also helps them recognize the importance, usefulness, and value of science in their personal lives (Belington, 2012).

In a study conducted on challenges teachers face in teaching science practical lessons by Millar (2010), it was confirmed that planning holds numerous implications for teacher. Primarily pedagogical content knowledge plays a vital role for the effective planning by any teacher. Pedagogical content knowledge refers to teachers' interpretations and transformations of subject matter knowledge in the context of facilitating learning. Remarkably, pedagogical content knowledge encompasses understanding of common learning difficulties and preconceptions of learners this will illicit how well planning should be carried out taking into account a number of aspects for a practical lesson to come out in a manner to be benefit the learners who is the focal point for the entire process. Millar (2008) emphasises that in planning an activity, the task should be tailored to achieve the identified aims, for example through discussion between learners.

Studies have shown that teachers' knowledge of how they plan and what they do in planning is implicit in their actions and not necessarily a process they can readily articulate. Belington (2012) postulates that important elements that teachers consider when planning, and the type of planning in which they engage into are cardinal in the process of teaching practical lessons in science. Additionally, there are number of aspects which are considered when planning and one of them is published curriculum material (Millar, 2010). With evidence from research teachers depend heavily on published curriculum and teachers' guides for content and methods which are the recipients for their planning.

The study of teacher planning is a relatively recent focus of research. As pan of the larger body of research concerned with teachers' thought processes, research on teacher planning has focused on that of experienced elementary teachers. Research on teacher planning is concerned with teachers' proactive and post active thoughts—i.e., those thoughts about teaching occurring prior to and following interaction with students, respectively. Based on the findings there a number of factors why teachers plan. However, some of these factors are in line with the teaching of practical lessons in integrated science. Research findings indicate that lack of proper planning makes a teacher not to be efficient. Millar (2010) suggests that teaching through practical activities require a great deal of planning, resourcefulness and commitment on the part of the teacher. The teacher must be conversant with laboratory skills. These include setting clear outcomes, good timing of activities, making the necessary apparatus and other materials readily available for all learners. Teaching Learning Materials in Science are helpful in bringing clarity to the difficult and abstract concept and phenomena related to various branches of science. Instead of striving hard with the verbal experiences or explanations. If the teacher makes use of some appropriate aid material, he can make the things more clear and meaningful to the learners regarding any subject. The teacher must be illustrative enough to capture the learners' interest and should makes use of some appropriate aid materials in the form of charts, models, photographs which can make the things more clear and meaningful to his learners (Millar, 2010). It is in this view that science teachers must be familiar with the handling and use of the various apparatus and chemicals that they are likely to use in the topics they intend to teach (Muzumara, 2008). Therefore, teachers need to have sufficient pre service training in laboratory activities and how they can use them to teach the learners.

Research has shown that mostly teachers teach science through lecturing and adoption of text book method. Johnson(2010) argues that this can't help in the proper development of the intellectual faculties of the children. It can merely lead to role memorization on the part of the learners without having any insight and understanding of the things and events. On the other hand the use of teaching learning material is capable of providing such learning opportunities which may stir the imagination, thinking process and reasoning power of the learners. It may also call for the originality, creativity, inventiveness and other higher mental activities on the part of the learners and thus they help in the nourishment and development of the mental faculties of the students at primary level which enhances the build-up of concepts in future

(Millar, 2010). Teaching learning materials in Science prove effective reinforcing agent by increasing the probability of the reoccurrence of the responses associated with them. Based on research evidence the experiences are so much connected and associated with the relevant used aids that the learner get sufficient reinforcement for keeping these experiences remembered for a long time. Most practitioners would agree that good quality practical work can engage learners help them to develop important skills, to understand the process of scientific investigation, and develop their understanding of concepts. Millar (2010) echoes that a good practical task is one that achieves its aims of effectively communicating a clearly defined set of ideas. Allowing time for learners to use the ideas associated with observed phenomena, rather than seeing the phenomena as an end in themselves, is vital if learners are to make useful links. Belington (2012) ascertains that what is learned by the learners in different subjects at one time may be said to be meaningful only if it can be utilized by them in their inter-related concepts with other subjects or meeting their day to day needs and solving the problems of their life use of Teaching Learning Materials help in this direction by making possible the appropriate positive transfer to learning and training from one situation to another. Studies today indicate that there must be utilization of teaching learning materials in dissemination knowledge either inside the classroom or beyond so that the use of teaching learning materials in the process of education provide valuable opportunities to the learners to make use of their five sense organs i.e., eye, ear, nose, tongue and skin for gaining valuable knowledge and information (Muzumara, 2008).In any scheme of teaching and learning the sensory impressions play the key role and that is why senses are usually termed as the gateway of knowledge. Therefore the teacher teaching practical activities should endeavour to make the lesson encompass all the senses and helpful in the positive transfer of the leant concepts. Millar (2010) stresses that the use of Teaching Learning Materials besides the use of printed and spoken word may help the teacher of various subjects in such a situation by providing an additional or alternative media for effective communication with the learners. The researcher is with the opinion that teachers lack meaningful communication in the classroom when teaching practical lessons. This is supported by Muzumara (2008) who argues that every experience gained at the time of learning leaves behind an image or impression in the minds of learners. The effectiveness of the learning depends upon the quality of this image or impression Teaching Learning Materials in Science provide such experiences that leave behind a permanent mark in the form of adequate impressions or image and thus aid to good retention and relatively permanent learning. Millar (2010) supports by pointing out that children are quite active by nature and enjoy listening and observing the things and phenomena. He urges teachers to present lessons with a view of capturing the learners' attention through the classroom activities which satisfies the needs of their urges, instincts, basic and motivates and thus prove a potent motivating force to energize their learning behaviour. This active participation and adequate experiences prove helpful in the establishment of proper educational environment and healthy classroom interaction for the effective realization of the teaching learning outcomes.

Belington (2012) considers the aspect of a teacher making use of a variety of teaching resources such as other teachers, the community and learners themselves. Science is one practical subject that demands a lot of resources. These are in terms of stationary and laboratory equipment (Belington, 2012). The biggest challenge for teachers and schools is obtaining these science materials for a meaningful lesson. For instance, a science laboratory has to be equipped with all the equipment so that learning becomes meaningful to a learner. Muzumara (2004) argues that effective science teaching takes place when all the pupils being taught attain the desired learning outcomes in science. However, the rate at which this is achieved will depend on a number of factors. Some of these factors may include, availability of teaching aids such as apparatus, chemicals and other science materials. The unavailability of these materials in the school makes learning difficult for learners. Additionally, the challenge currently is that most primary and secondary schools do not have conventional science laboratories to support practical aspects of science teaching and learning. To address this challenge, the National Science Centre, with financial assistance from JICA and Ireland through the education sector pool fund, has been producing the mobile science laboratory kits. This means that pupils can experience effective learning of science. In addition to the distribution of the kits, laboratory equipment, chemicals are procured and distributed for teaching and examination purposes. Furthermore, a number of teachers and lecturers from colleges of education are trained in the appropriate and innovative use of the kits.

Belington (2012) observed that limited learning facilities affect the teaching and learning of science subjects to learners. When classes are lacking adequate resources and laboratory space is limited, learners fail to benefit from classroom instructions. This is because the learner is deprived of attention to the human element of scientific activity and the task of construction of ideological and scientific creativity, the analysis which contributes to the development of scientific ideas. The learners need extra attention and support from teachers in order for them to grasp academic concepts and the development of an ability to function autonomously in an area of science studies to solve practical problems and to communicate such experiences to others is curtailed (Muzumara 2004). It is vital, therefore, that they are given extra time and individual attention away from the regular class in order for them to learn and progress in science. Therefore, lack of the resources available to perform these recommended types of activities are sometimes very limited which negatively affect the teaching and learning of science (Gilbert, 2006). This aspect results in poor planning by the teacher. All teachers know that planning is a critical component of effective teaching. Millar (2010) explains that one important aspect of planning is setting goals. In the vision of science education, teachers take responsibility for setting year-long and short-term goals; in doing so, they adapt to school and as well as national goals, to the experiences and interests of their learners individually and as a group. Therefore, this gives an opportunity to both teachers and learners to perform experiments and manipulate materials of science for developing learners' understanding and appreciation in science subjects. Teachers also may change their plans based on the assessment and analysis of a learner achievement and the prior knowledge and beliefs students have demonstrated (Gilbert, 2006).

Based on studies classroom management and effective discipline are skills that all teachers must learn. Classroom management refers to those procedures or routines a teacher uses to maintain a smoothly running classroom; discipline refers to those techniques or strategies a teacher uses to respond to specific acts of student misbehavior (Kelly, 2009) Traditional classroom management practices are typically characterized by the teachers' strict and rigid imposition of classroom rules on the students, which are designed to evoke fear in students so that they would adhere to the teachers' expectations (Millar, 2004). However, the rise in chronic behavioral problems in the classrooms such as disruptive behavior and noncompliance in recent years testifies to the ineffectiveness of this type of classroom management approach (Lohrmann & Talerico, 2004). When it comes to teaching of practical lessons a teacher has to know how to control the class. Indiscipline on the part of pupils increases risks in practical activities and risk assessment should be taken into account. As alluded to large classes can create a great deal of management problems. Muzumara (2008) cites that it is important for teachers to control the number of learners they can manage for a particular practical activity. The researcher is with the view that it is helpful to divide the class into small and manageable groups for a practical lesson where possible. The learners are expected to be engaged in activities which are risk free to facilitate proper learning. It is the duty of the teacher to carry out risk assessment to create good working habits during science activities. Johnson (2010) points out that the success of a teaching learning process depends upon the healthy classroom interaction and proper educational environment of the class. However, the problem of classroom indiscipline in many ways has its roots in the uncongenial and unhealthy classroom environment. Based on Johnson, (2010) study, when pupils are kept passive as recipients of the knowledge and are bombarded through extreme verbalism, they are bound to get bored, fatigued or lose interest in learning. This may be the resultant of failing to manage the class on the part of the teacher and in such a situation may generate indiscipline in the classroom. Additionally, a close observation of classroom behaviour shows that noise makers tend to concentrate at the back of the class. It is found that such learners at the back do not participate much in the lesson is therefore not surprising. This however calls for better strategies or skill from the teachers to handle such type of the section of the class. Johnson, (2010) echoers that with strategies and skill to manage a class from the teachers there is very little scope left for the creation of anarchy and uninteresting environment in the classroom. Moreover it provides a variety creative channels for the learners to utilize their tremendous energy which might be otherwise use for making mischief and creating indiscipline in the classroom.

Research has proved that the sitting arrangement can have a bearing on a lesson. In terms of practical lessons lack of proper supervision of the class may have a negative bearing on the lesson. Muzumara (2008) observed that Ideally in a secondary school especially in in a mixed ability grouping as found in Zambia schools seats should be arranged in rows with a reasonable amount of space between them to allow for proper teacher- learner- learner interactions well as for individual and group work. The ratio of teacher – learner should not exceed 1:40 or most 45 judging by the size of the classroom. But what one finds in many of the classes is between the ratio of 1:50 or 1: 60 in certain cases. This poses a very big challenge where most science teachings are teacher-centered, and are based on memorization of factual knowledge. Thus teachers teach classes by using typical lectures in science at all levels and especially at primary and secondary schools. The consequences of this situation lead to rote learning on the part of learners, with no deep understanding of scientific concepts, phenomena and theories. They are denied to learn through practical which is based on doing experiments or activities. The method derives strength from the view that if learners are provided the opportunity to think and solve problems on their own, then the learning becomes long-lasting. The important features of activity-based teaching are that it is learners centered and it encourages self-leaning. It also allows the learners to study according to his or her own ability and skills.

A teacher has to overcome challenges, especially when teaching practical lessons (Hofstein and Lunetta, 2004). Teaching for understanding requires responsiveness to learners so that activities and strategies are continuously adapted to suit the level of the learners. Muzumara (2004) emphasises that planning calls for a careful thought and goes on to say that science teachers should have the knowledge, skills and ability to select, organise and utilise the many materials at their disposal that suit a particular class setting. According to the study done by Millar (2010) on planning how to teach practical lessons, that it is good for the teacher to plan as it helps the teacher to intermingle the activities with the details of the information and skills being taught. This brings about meaningful and effective learning. Additionally,Integrating Science and Mathematics Teaching poses problems, learners will naturally require use of mathematics, so combining instruction in both subjects, along with English language skills development, reinforces learning of each. A practical lesson calls for instructions which can pose a challenge in terms of carrying out the activity if the instructions are not clear. Millar (2010) points out that it is especially important for leaners to use mathematics to answer questions arising from their coursework; solving math problems they themselves have created will help them better appreciate math's practical usefulness. This evidently qualifies the statement and brings to light the importance of integration of subjects. Further, integration of science, mathematics, and English language learning obviates the need for the common and fragmented English as a Second Language or remedial math "pull-out" instruction that is less effective and stigmatizing for students. Belington (2012) observed ssuch a curriculum must help young learners make connections between their generation and those of the past for them to learn most successfully.

Studies all over the world bring out the view that Education is not only a human right, but it is an essential tool for individuals to break the poverty cycle and to building the human capital of any country Zambia inclusive. Kelly (2008) cites that with education increasingly becoming the primary determinant of overall development in the emerging knowledge economy there is need to enhance ideas that promote it. However, in a number of countries specifically developing countries Zambia in particular funding of education sector has been challenge. There have been number of policies in Zambia to increase access to quality education for all citizens. However, the lack of funding means that the much-needed materials will not be available thereby affecting science lessons for the learners. The Ministry of Education Annual Report for 2002 provides a picture of the performance of the Ministry for that year against set national targets. From the study, Bell (2011), stresses that aaccessible and high-quality education can, therefore, be said to be the most important investment a government can make, simply because it is practically not possible for any country to succeed in the pursuit of other human endeavours without adequate pools of skilled and enlightened citizens. The Zambian government has strived with this in mind by bringing a number of partners on board to help in terms of funding the education sector. Despite the efforts the Ministry of Education Annual Report for (2002) reviewed that the Ministry continued to be least funded in the sub region and from this, it can be claimed that the teaching of science can be affected negatively. Regular schools country wide struggle with funding to their science department and the situation is even worse when it comes to rural schools (Kelly 2008). Due to poor financial management, some donors decide to stop funding schools questioning whether or not the money is benefiting the intended parties (Suttan *et al*., 2008). Many schools that depend on government funding are also negatively affected when government fails to fund them. There is well-documented evidence of the shortcomings of equipment funding and replacement of laboratories which require continued monitoring and should be addressed as part of a wider strategy and improvement in facilities (Muzumara, 2008)

Research findings, according to Bell (2011), demonstrate that the influence of society's attitude and perception on the learners is strong and pervasive.It is a challenge to educate stakeholders, beyond members of scientific communities and researchers in science education, to include representatives of business and commercial groups, politicians, parents and local and national authorities. This involvement is essential for the support of teachers and learners and for a renewal of the curriculum, both national and international (National Research Council, 2007).Six key factors come to the fore. The first is a curriculum based on science as process rather than a product, with the focus on deeper learning. The second factor is adequate and appropriate teacher education, as basic education crucially depends on the person who brings about the curriculum, whether present in the classroom or a remote or virtual teacher. Thirdly, those strategies that support such a vision of science education. International investigations and specialists all point to the value of a learner getting involved and becoming active and focus on the strategy which describes learning as an active, internal process of constructing new understandings. Additionally the theory the teacher applies to put the concepts across to learners is of paramount importance. The study by Bell (2011), argues that mmodern learning theory describes learning as an active, internal process of constructing new understandings. In some instances, a newly constructed idea fits easily into the structure of existing understanding. In other cases, the construction of new understanding catalyses substantial revision of existing knowledge into a new, more coherent framework. In still other instances, new and old ideas conflict but are retained and used separately. Research evidently cites that learning is also a social and cultural process. Individual learners' interactions with their peers are important to each learner's active construction process and the group process. The construction of deep scientific knowledge results from actively practicing science in structured learning environments. This translate into learning environments supporting learners' active construction of knowledge. Teachers should employ teaching strategies that help learners recognize conflicts and inconsistencies in their thinking, as these experiences catalyse the construction of new, more coherent knowledge. Recent literature concerning the role of school laboratory echoes with several themes: information literacy, lifelong learning, critical thinking, hands on learning and resource-based learning. These themes emphasize the changing role of the school laboratory one that is characterized as an instructional partnership between teachers and the learners. The call for a more proactive role in the instructional process aims at reasonably delegating the responsibility of learning to a child to manage the process through. This concept necessitated the production of mobile labs in Zambia to bridge the gap in those schools lacking conventional labs. Classroom teachers teaching science have a duty to professionally to demonstrate to the learners in a manner pertaining experimental presentation of lessons, (National Research Council, 2007). This does not only avail learners to the correct strategies but to self-sustainability and accord them a full participation in the learning process.

The impact of the negative attitude and discrimination on the child is the discouragement of independence and initiative, the limitation of adaptive skills and the development of feelings of inferiority. Chapman and Stone (2009) despondently point out that such stigma and discrimination sometimes come from teachers who are supposed to be role models and thus, contribute to the growth of these pupils. Another research study confirms that parents' comments, beliefs and interactions with their children have a profound influence on the child learning of science. Parents message contain an underlying message which may influence the child either positively or negatively. This calls for the science teacher to have the responsibility to develop in learners' abilities and attitudes of acting scientifically by applying scientific knowledge, understanding and skills in individuals and collective situation. Suttan *et al*., (2008) further observe that teachers may undermine the academic potential learners may possess especially the girl child to learn science subjects. Unfortunately, studies have confirmed the fact that when individuals are brought to form a negative opinion of them through the process of conditioning, it becomes difficult for those individuals to decondition themselves hence some learners, specifically, girls believe that they cannot learn science. A large body of experimental research found that negative stereotype affects girls' performance and aspirations in science through a phenomenon called stereotype threat. According to Gardner (2008), every person must be scientifically literate despite their gender in order to function effectively in the present scientific and technological society. This is one of the central goals of science education and should stand as the major concern of the science teacher. Every learner should be enlightened in a variety of disciplines of science in order to widen their scope of science and technology as a way of preparing them for the multiple roles in society. As always, there is the tension between the local, namely student relevance, matching the interests of the learners and their contexts; and the wider context, the need to prepare students to go beyond their immediate environment to a wider view of the world and its possibilities. This tension can be alleviated by helping students not only to learn the processes and content of science but also to help them reflect on their learning so that they will be better able to go beyond their immediate contexts. Through their science lessons, learners in basic education should learn to search for information from a variety of sources both first and second-hand; to sort and classify; to explain their findings; to offer conjectures and refutations of their views and those of their peers; to suggest hypotheses; to devise and carry out investigations to investigate these hypotheses, evaluate the outcomes of such investigations(Gardner,2008).To meet such demands, teachers need support in developing their pedagogical, didactic and subject knowledge for basic science teaching. As in the parallel report on mathematics, especially in primary schooling, teachers have had little education in science. This is a particular problem in countries where there are numbers of unqualified teachers or where their own education goes barely beyond secondary level (Bell 2011).

2.6 Chapter Summary

This chapter has covered a brief history of mobile laboratories in Zambia then reviewed literature on three main themes deduced from the objectives, namely; the effectiveness of mobile laboratories in teaching of Integrated Science practical lessons in primary schools, the effects of teachers' competencies on the teaching of Integrated Science practical lessons in primary schools as well as the academic challenges faced by teachers in teaching Integrated Science practical lessons using mobile laboratories were developed.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.0 Introduction

This chapter presents the research methodology. The elements described in this chapter are research design, research population and study sample, sample and sampling procedure, research instruments the data collection and data analysis procedures.

3.1 Research Problem

The problem under focus in this study relates to the teaching of practical lessons using Mobile laboratories and the views of the science teachers who are using these mobile laboratories. The importance of practical work has been identified by many authors. Millar, noting that students need to think as well as act, pointed out that Duckworth (1990) had noted that effective tasks are those where learners are not only *'hands on'* but also *'minds on'* (Millar, 2010). In Millar's opinion, improving the quality of practical activities: requires first that teachers become more aware that making links between the domain of objects and observables and the domain of ideas is demanding, and then helping them to design practical tasks which take this demand more explicitly and fully into account. This clearly ratifies the importance of practical lessons to a learner. In Zambia, the policy document Educating Our Future (1996) embraces Science to be taught with the involvement of the learner. In Zambian schools specifically, those without conventional laboratories, mobile laboratories have taken a centre stage and teachers take into account what resources to use and how these will affect the learners. The teacher is expected to have the necessary background information about the class, the teaching environment and the type of materials such as chemicals, apparatus and equipment to be used.

It is essential that science teachers understand the meaning and nature of science in order for them to have a clear picture of what they need to teach and how best they can teach it. The starting point for improving practical work is, therefore, to help teachers become much clearer than many are at present about the learning objectives of the practical tasks they use (Hart *et al.,* 2000).

Several research studies account for the benefits of practical lessons in the teaching of science in relation to the theoretical approach which is very dominant in Zambia (Ministry of Education, 1996). This is not only a challenge to the learner but the teacher, as well as science, needs to be interpreted at an individual as well as collective level (Millar, 2010).

These aspects were explored in this study by asking relevant questions in the open-ended questionnaire, interviews and observational checklist and the study had to explore Integrated Science teachers' views on the use of Mobile Laboratories.

3.2 Research Design

Kombo and Tromp (2009) state that a research design is a scheme or plan that is used to generate answers to research problems. Additionally, Ngoma (2006) defines a research design as a set of logical steps taken by the researcher to answer the research questions. In this wide sense, it is a programme to guide the researcher in collecting, analysing and interpreting observed facts. In this research, a survey design was used in collecting data. According to Zikmund (2003), a survey is a research technique in which information is gathered from using a questionnaire. The researcher mainly employed a quantitative method in collecting data with the use of a well-constructed questionnaire whose questions solicited the desired information. Interviews and classroom observation enhanced validity and detailed information about my study. This further helped me to eliminate bias that may have been eminent if I had relied on only one source of data. Observation and interview schedules were employed to collect qualitative data

3.3 Research Population and Study Sample

According to Bless, Higson and Smith (2004), a study sample is the entire set of objects or people which is the focus of the research and about which the research wants to determine the characteristics. Additionally, Agreti and Fin (2009) point out that population is the total set of objects of interest in a study. The study involved all the teachers of Integrated Science into the Eastern and Northern Provinces of Zambia. Then the study sample was purposively taken from four (4) districts of Eastern Province and four districts from Northern Province with their respective schools where teachers teaching Integrated Science using mobile laboratories were picked for the study.

3.3.1 Schools from Eastern Province were:

1. Chisale	5. Kaulu	9. Katete
2. Chiparamba	6. Kalambakuwa	10. Kasenga
3. Gonda	7. Kapara	11. Mbwindi
4. Katete	8. Kapasa	12. St Margret's

3.3.2 Schools from Northern Province were:

1. Chileshe Chepela	5. Laura
2. Chishimba	6. Mungwi
3. Luwingu	7. Musa
4. Lunte	8. Ituna

3.4 Description of the Sample (Demographic Data)

The sample covered a total of twenty primary schools. These schools were located in four districts of Eastern Province and four districts Northern Province. A total of forty-five (45) respondents completed the questionnaires of which thirty-six (36) were male and eight (8) were female.

Table 1: Summary of the Study Sample

Province	District	Respondents	Total
Eastern	Chipata	12	12
	Katete	4	4
	Nyimba	4	4
	Petauke	3	3
Northern	Kasama	11	11
	Luwingu	4	4
	Lunte	4	4
	Mungwi	3	3
			45

3.5 Description of the Sample by Qualification

The total sample of the respondents were forty-five (45) of which the majority were Bachelor's Degree holders (20), followed by Diploma holders (17), Certificate (7) and the minority, Master's Degree (1). This entails that the significant majority (21) of the respondents were university graduates. Therefore, these are qualified teachers to teach Integrated Science.

Table 2: Summary of the Educational Qualification in the Sample Schools

Qualification	Total
Certificate	7
Degree	20
Diploma	17
Master's Degree	1
Total	**45**

3.6 Sample and Sampling Techniques

A sample is the representative group from which the researcher draws the current events within the population. Kasiulu and Tromp (2009) define it as a technical accounting device to rationalise the collection of information to choose in an appropriate way, the restricted set of objects, persons, event and so forth from which actual information will be drawn. The sample for this study comprised of forty-five (45) teachers who were purposively selected based on the condition that they taught Integrated Science in their schools. Twenty (20) schools which have mobile science laboratories were also purposively selected to make a sample for the study.

Basically, the sampling technique used was purposive sampling which is a non-probability sampling procedure in which respondents are selected purposively. I used purposeful sampling which allowed me to choose the site and participants who illustrated the features which the researcher was interested in for the relevance of my study (Lodico, Spaulding, &Voegtle, 2010; Silverman, 2001). The researcher selected the schools that where using mobile labs to teach integrated science. The key participants in this study were science teachers; hence only chose teachers who teach science in those schools. A total of forty five science teachers from Eastern and Northern provinces of Zambia were included in this study. Purposive sampling procedure has an advantage in that the purpose of the study can be fulfilled even with a small sample which is picked purposely and carefully. Additionally, the technique was used to ensure that a fair representation and distribution in terms of the teachers traced at these institutions had areas in the teaching of Integrated Science.

Table 3: Distribution of the Sample by Age and Gender

		AGE				Total
		0-25 Years	26-35 Years	36-45 Years	46 + Years	
GENDER		0	0	1	0	**1**
	Female	1	7	0	0	**8**
	Male	0	23	11	2	**36**
Total		1	30	12	2	**45**

3.7 Data Collection Instruments

In order to solicit views from the teachers teaching Integrated Science, questionnaires, interview schedules and an observation checklist were used to collect data needed for this study. The combination of these instruments was meant to increase the reliability of information collected for the study.

Questionnaires were used for the teachers because they were able to read and write in print and since the schools were spread throughout the two provinces. Additionally, the questionnaires were economical in terms of resources and time. They also allowed the respondents to express their views freely. Interviews were also used as they allowed the researcher to go deeper into the issues that were being researched. Observation checklists availed the researcher with an opportunity to interact with the learners in the actual environment which optimised the availability of information.

The questionnaire was divided into two sections. Section A captured demographic information of the respondents such as status, gender, age and work experience and Section B contained items on anticipated factors which pose challenges in the teaching of practical lessons using mobile laboratories. The survey on the factors which pose challenges in the teaching of practical lessons using mobile laboratories respondents responded to by ticking on the preferred choice (Yes or No) and by providing brief written explanations where it was required.

The interview schedule consisted of brief explanatory questions which were done orally. One-on-one interviews where employed and each teacher was interviewed for about 30 to 35 minutes. This allowed individual teachers to express their views and feelings without fear of other participants (Bryman, 2004). Semi-structured interviews that enabled the researcher to probe for further information on teachers' experience. Probing enables the researcher to explore new paths which were not initially considered by the participants (Gray, 2009; Lodico et al., 2010). An interview guide was used so that helped me to be focused, systematic and to avoid repetition during the interview. Asking repeated questions during the interview is discouraged as commented by Walliman (2006) because it negatively influences the desire of the respondent to answer questions.

After the interview, it was vital to observe the teachers in action. The observations done in the classroom were on account of teachers operating in their natural setting which is an important feature of case study (Gay &Airasian, 2003; Yin, 2009). I visited the classrooms once before the intended observation. Through the visit, I got the opportunity to introduce myself to the students as a visitor and sit throughout the lesson without making any note or recording in order to familiarize myself with the teachers and students. I conducted two observations of each teacher in different classes. These assisted me to get a holistic picture of the teachers' practice from their classrooms. In addition, these observations enabled me to verify teachers' responses from the interviews in relation to the real classroom setting (Robson, 2002). During the teaching and learning of science, an observation schedule supported me to record the events taking place in the classroom. It also helped out to concentrate on the teachers' practice during the teaching and learning process. Maxwell (2005) comments that observation schedule helps the researcher to be systematic and capture the whole social setting in which people work. The observation checklist provided direct behaviour which was put in context thereby understanding it better. The teachers and the learners interacted positively to help the researcher to collect data from the authentic environment.

3.7.1 Piloting Research Instruments

According to Tuckman, (2003) it is important to pilot test a questionnaire in order to revise the items based on the results of the pilot test. The purpose of pilot testing is to reveal any defects in the research instrument (Jack and Norman, 2003). In line with what Jack and Norma cited above, the self-administered questionnaires were distributed to the six teachers. The piloted respondents did not form part of the study sample. The aim was to check on the validity and reliability of the questionnaires. The questionnaires could not be piloted in the three schools as earlier planned due to logistical challenges. The piloting provided the basis for determining the duration for the completion, identification of those questions which were vague, and counter checking the content which was paramount in the questionnaire. In principle, a pilot study increases the reliability, validity and practicality of the questionnaire (Creswell, 2013).

3.7.2 Observations from the Field on the Questionnaire

The findings of the field piloting revealed some aspects that had been overlooked which needed to be included in the final questionnaire. The major observations were:

- The demographic data had been omitted; and
- Experience of respondents as teachers.

All the observations which came to light from the questionnaire were addressed and changes made in accordance with the modifications. The total time for the respondent to complete the questionnaire was between twenty to twenty-five minutes. The rest of the variables remained the same except for minor spelling errors that were rectified.

3.8 Procedure for Data Collection

Data collection is gathering information of suitable information for the survey from selected respondents. The researcher was given the Certificate of Clearance to enable her to collect data from the field. Another letter of authorisation was obtained from Provincial Education Administration from Lusaka and was presented to institutions and respondents. They were approached and the purpose of the study explained to them, with a consent form (Appendix F) was provided for them to sign.

The questionnaires were administered by the researcher and the Assistant researcher to the respondents. The researcher explained to the respondents how the questionnaire was to be filled in and made clarifications on any question which arose. Anonymity and confidentiality of the respondents were considered and assured to all respondents. Questionnaires were distributed and collected thereafter. To ensure confidentiality, the names and identification for personal information were not required.

As for the interviews, the researcher worked hand in hand with the assistant researcher to collect data from Eastern and Northern provinces of Zambia. The researcher had already prepared the questions which were asked and responses were written down as well as recorded.

The researcher personally observed the practical lessons being conducted by the teachers and used Observation checklist to collect data which gave the researcher an opportunity authentically to collect data from the actual environment. This accorded the researcher an opportunity to interact with both the learners and the teachers. It became an added advantage in terms of acquiring information.

3.9 Data Analysis

Data analysis process ran as shown in the following table:

Table 4: Summary of Data Analysis

Questions	Data Collection Tool	Data Analysis
1: What are teachers' views of the mobile laboratory for science practical lessons?	Questionnaire for the science teachers teaching Integrated Science.	SPSS ver. 20
2: How do teachers teach practical lessons using mobile laboratories?	Lesson observation	Thematic (formation of themes)
3. What is the role of the mobile laboratory in the teaching of practical lessons in science?	Interview schedule	Thematic formation of themes.

3.10 Validation and Reliability of Instruments

The instrument for data collection in this study was validated in two ways.

Face validity and content validity. The supervisors looked at the structure of the questionnaire and its appropriateness. The questionnaire was also checked by a specialist in teaching science so as to ensure relevance to the main problem of the study. The supervisor's recommendations were included in order to improve the research instrument.

In testing for the reliability of the questionnaire, a pilot study was conducted using ten (10) science teachers from primary schools. These science teachers were not included in the main study. The reliability of the instrument is to be determined by calculating the Cronbach's alpha reliability method.

3.11. Trustworthiness

The researcher made efforts to ensure trustworthiness throughout the study; for example, data was recorded and made the write up after every field visit to organize the data. The multiple sources of data collection were triangulated so as to corroborate the findings. This ensured the researcher to have a more valid, reliable data and make a diverse construction of realities of teachers' views and opinions of their teaching practices (Golafshani, 2003).

The researcher with the assistance of the Research Assistant interviewed the teachers teaching integrated science. The researcher personally observed the practical lessons and took down the notes together with the field notes to ensure the accuracy and credibility of the data collected. In addition, Member checks were conducted with the teachers by going through the records with them to ascertain that what the researcher had was a true record of what they had said. This helped to establish the accuracy of data before reporting (Bogdan &Biklen, 2007). Moreover, the researcher gave a detailed description of each process of the study. Creswell (2009) contends that when a detailed description of the research process is given, the results become more realistic. Additionally, the researcher also kept safe all recorded documents such as transcripts of interview and focus group discussion, observation and field notes records. Additionally, to ensure safety and data protection from any loss, I had a backup of the recorded data. This also helped me to preserve older copies so that I could retrieve the data whenever needed.

3.12 Ethical Consideration

Scholars Jack and Normal (2007) posit that in planning a study, researchers have a responsibility to evaluate carefully and ethically any ethical concerns of the study. The study involved my interaction with science teachers through interviews and classroom observation within their schools' context. Therefore, the issue of ethical consideration was very important to ensure willing participation of teachers (Creswell, 2009). This was done by following all necessary steps starting from obtaining clearance from the Ethics Review Committee UNISA to conduct the study. The researcher then sought permission to conduct research from Ministry of General Education in Zambia, Provincial Educational Officer and also sought permission from Head teachers of the schools. After explaining to the head teacher the nature and the purpose of my study, I gave them the research information sheet for further information and references. The head teachers helped me get access to the science teachers. It is in this line that the study was conducted in an ethical manner, protecting participants' rights to anonymity, confidentiality and autonomy. Confidentiality was upheld by ensuring that the identification of the participants was concealed. To ensure that anonymity was upheld, no data that would be used specifically to trace the identity of any participant was collected. The participants were not coerced; they were given the choice to participate voluntarily and the freedom to withdraw from the study at any time without giving reasons. The purpose of the study was explained to the participants, with a consent form (Appendix F) provided for them to sign. More importantly, the research complied with the University of South Africa's (UNISA) ethical guidelines, as well as the Ministry of Education's requirements for conducting research in Zambian schools.

In addition, the researcher interviewed those participants according to their own convenient time with prior appointment. This enabled me to avoid interrupting their school's schedule. For confidentiality and ensuring anonymity, I used pseudonyms for both the schools and participants for the purpose of protecting their names. All the data was kept in a locked cabinet while soft copies were stored using computer passwords and no information was shared with anyone during and after the study. This ensured that the data was only used for the intended purpose of the study.

The researcher intends to share the report of the study with the participants by providing a copy of the findings as a means of reciprocity. This would help to confirm that it is the true reflection of their views. This is in line with Bodone's (2005) comment that, it is the researcher's responsibility to share the findings of the study with the participants because they have the right to know if what has been reported are from their own views.

3.13 Challenges Faced During the Data Collection

The researcher faced some challenges in the data collection process. One problem was that the two provinces are quite some distance from Lusaka and the researcher relied on the assistance researcher to drive to these distant provinces to collect data. Additionally, when the data collection process commenced, there was a reluctance by the respondents to fill in the questionnaire despite them signing the consent form. This attitude of apathy could be attributed to the respondents participating in so many studies where it was observed that they never got any feedback. Furthermore, during the observation of the lessons, some classrooms were so crowded that it was very difficult to observe the practical lesson adequately due to barriers in terms of not having enough materials in the mobile laboratories. From one of the schools in

Eastern Province, the class had to be divided into two sessions just for the researcher to get data. This posed a challenge to the researcher in terms of financial constraints. The other aspect was the anxiety by the researcher due to a number of questionnaires which were given out to the respondents. There was fear that some respondents may not fill in the questionnaire as due to the apathy. However, the response was positive and very encouraging.

On the other hand the researcher‘s plan was to involve fifty teachers in total from the two provinces. However this target was not attained due to the long distance where one of the school was located in Northern Province. The resolution was to get another school where the questionnaire were not retained and the researcher did not manage to touch the school due to time factor.

3.14 Chapter Summary

This chapter has covered the methodology used in the study. It described the location of the study which was Eastern and Northern Provinces of Zambia. The research design adopted by the study was the descriptive quantitative survey. The target population of the study was all the science teachers in Eastern and Northern Provinces of Zambia. The sample comprised 45 teachers who were purposively selected based on the condition that they taught Integrated Science in their schools. Twenty (20) schools which have a mobile science laboratory were also purposively selected to make a sample of the study. The chapter further described the research instrument used. These included a self-administered structured questionnaire, observation checklist and interview schedules. Data collection procedures, data analysis, trustworthiness, ethical consideration of the study and challenges encountered during data collection were also covered in this Chapter.

CHAPTER FOUR

PRESENTATION OF FINDINGS

4.0 Introduction

This chapter presents the data collected from the field. The data is presented qualitatively and quantitatively. The frequency tables and graphs are used to give a clear and interesting picture of some of the collected data to the reader. The data is presented according to the themes in the instruments and in line with the objectives and questions of the research. Three main themes deduced from the objectives, namely; the effectiveness of mobile laboratories in teaching of Integrated Science practical lessons in primary schools, the effects of teachers' competencies on the teaching of Integrated Science practical lessons in primary schools as well as the academic challenges faced by teachers in teaching Integrated Science practical lessons using mobile laboratories, were developed.

4.1 Data Organisation

As stated earlier, the sample of this research was made up of different schools from Eastern and Northern Provinces of Zambia. From these schools, a sample of forty-five (45) respondents was selected. The information about distribution and collection of the questionnaire from the sample schools is summarised in the following table

Table 5: Presentation of Respondents by School and District

		DISTRICT									**Total**
		CHIPATA	**KASAMA**	**KATETE**	**LUWING**	**MPOROKOSO**	**MUNGWI**	**NYIMBA**	**PETAUKE**	**SINDA**	
SCHOOL	CHILESHE CHEPELA	0	2	0	0	0	0	0	0	0	2
	CHIPARAMBA	4	0	0	0	0	0	0	0	0	4
	CHISALE	0	0	3	0	0	0	0	0	0	3
	CHISMBA	0	1	0	0	0	0	0	0	0	1
	GONDAR	3	0	0	0	0	0	0	0	0	3
	ITUNA	0	2	0	0	0	0	0	0	0	2

	KALAMBA KUWA	0	0	0	0	0	0	2	0	0	2
	KAPARA	2	0	0	0	0	0	0	0	0	2
	KAPASA	2	0	0	0	0	0	0	0	0	2
	KASENGA	0	1	0	0	0	0	0	0	0	1
	KATETE	0	0	2	0	0	0	0	0	0	2
	KAULU	0	0	0	0	0	0	0	2	0	2
	LAURA	0	3	0	0	0	0	0	0	0	3
	LUNTE	0	0	0	0	2	0	0	0	0	2
	LUWINGU	0	0	0	3	0	0	0	0	0	3
	MBWINDI	0	0	0	0	0	0	0	0	2	2
	MUNGWI	0	0	0	0	0	3	0	0	0	3
	MUSA	0	3	0	0	0	0	0	0	0	3
	ST MAGRET	2	0	0	0	0	0	0	0	0	2
	ST MAGRET	1	0	0	0	0	0	0	0	0	1
Total		**14**	**12**	**5**	**3**	**2**	**3**	**2**	**2**	**2**	**45**

As reflected in the table, the 20 schools were selected from 9 districts, where 45 respondents were chosen to provide the information needed for this study. As for the respondents' characteristics, the following table is suggested for details:

Table 6: Respondents by Age and Gender

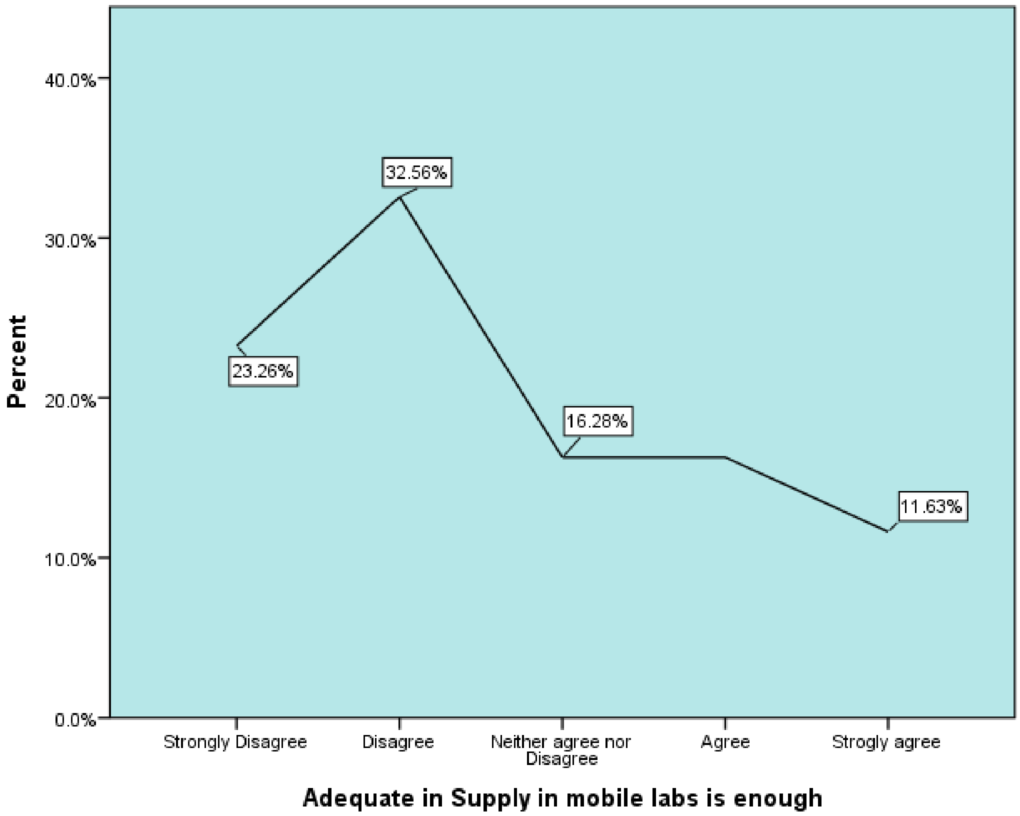
		AGE				Total
		0-25 Years	26-35 Years	36-45 Years	46 + Years	
GENDER		0	0	1	0	**1**
	Female	1	7	0	0	**8**
	Male	0	23	11	2	**36**
Total		1	30	12	2	**45**

The observation of data in the table reveals that the majority of respondents in the schools visited during the data collection were male teachers, representing 80 per cent of the total sample. This is because the biggest number of science teachers in the sampled schools were males. In terms of age groups, the majority of teacher respondents were aged between 26 and 35. The information obtained from these respondents is presented in the following sections.

4.1.1 The Effectiveness of Mobile Laboratories in Teaching of Integrated Science Practical Lessons in Primary Schools

One on the criteria of the effectiveness could be in the sufficiency of a number of items present considering the number needed. In order to find out information related to this point, the question to the quality of laboratories supply was posed and the responses given are presented in Figure 1 below.

Figure 1: Adequacy of Supply in Mobile Laboratories, According to the Teachers



The figure suggests that the majority of teachers (55, 82%) consider the supply in mobile laboratories to be inadequate while only 29.9 per cent regard this laboratory supply to be well enough. This insufficiency was also emphasised in an interview with teachers where the majority of respondent shared the same view as one teacher who said *"Some materials needed for practicals are not there in the mobile laboratory*" and another added that *"The materials are very few and are only used for demonstrations"*. The teachers further explained that, as compared to the number of students in schools, the mobile laboratories could not meet the needs for the practical activities. This is shown in the following quotation from one participant: "*The number of learners in classes is usually above 40 which is quite a big number.*"

The question aiming at finding the teachers' satisfaction in the mobile laboratory in comparison to the fixed laboratory was asked. The findings are presented in the following table.

Table 7: Teachers' Consideration of the Level of Beneficence of Mobile Laboratories as Compared to Conventional Laboratories

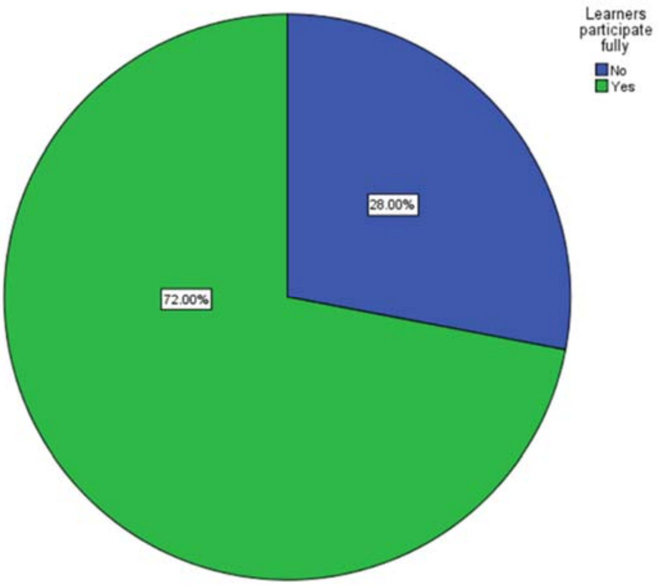
		Frequency	Percentage
Valid	Strongly disagree	11	24.4
	Disagree	12	26.7
	Neither agree nor disagree	4	8.9
	Agree	13	28.9
	Strongly agree	4	8.9
	Total	44	97.8
Missing	System	1	2.2
Total		**45**	**100.0**

Looking at the results in Table 7, 51.1 per cent of the teachers in the sample feel they do not benefit enough from the available mobile laboratories in schools, while 37.8 per cent regard the mobile laboratories to be useful in their activities.

Answering to the question concerning the benefits of these laboratories, one teacher said: *"Pupils are motivated when things are happening especially if the lesson involves locally available materials."* However, the majority of respondents shared the same views as one who said: "*Due to limited apparatus, experiments are done by demonstration and when working in groups and as a result, some learners in groups were not participating in the practical.*"

The direct observation also revealed some advantages of the practical lessons in Integrated Science in terms of learners' participation in the processes.

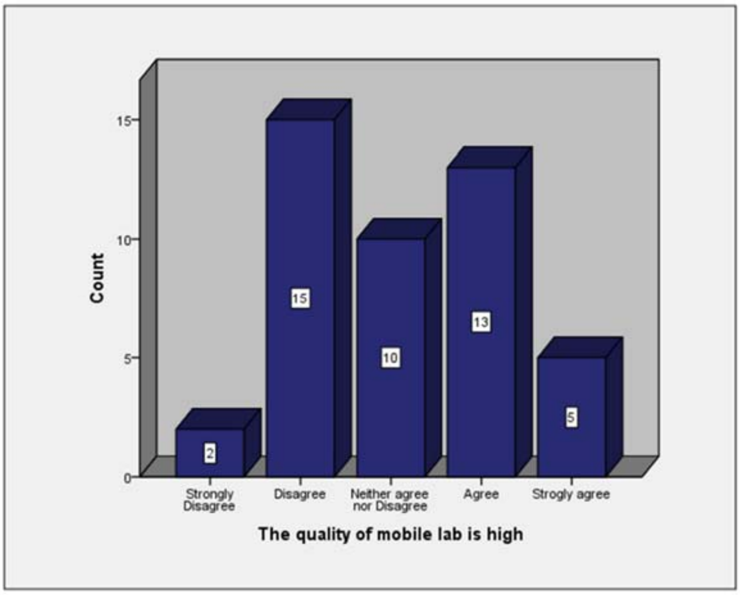
Figure 2: Learners' Participation in the Practical Lessons



The observation sessions were conducted in 25 schools and the outcome shows that in 72 per cent of the schools, the learners were able to participate fully as a result of the use of the mobile laboratories.

The research also sought to find out the perception of teachers of the quality of the available mobile laboratories and the outcomes were as follows:

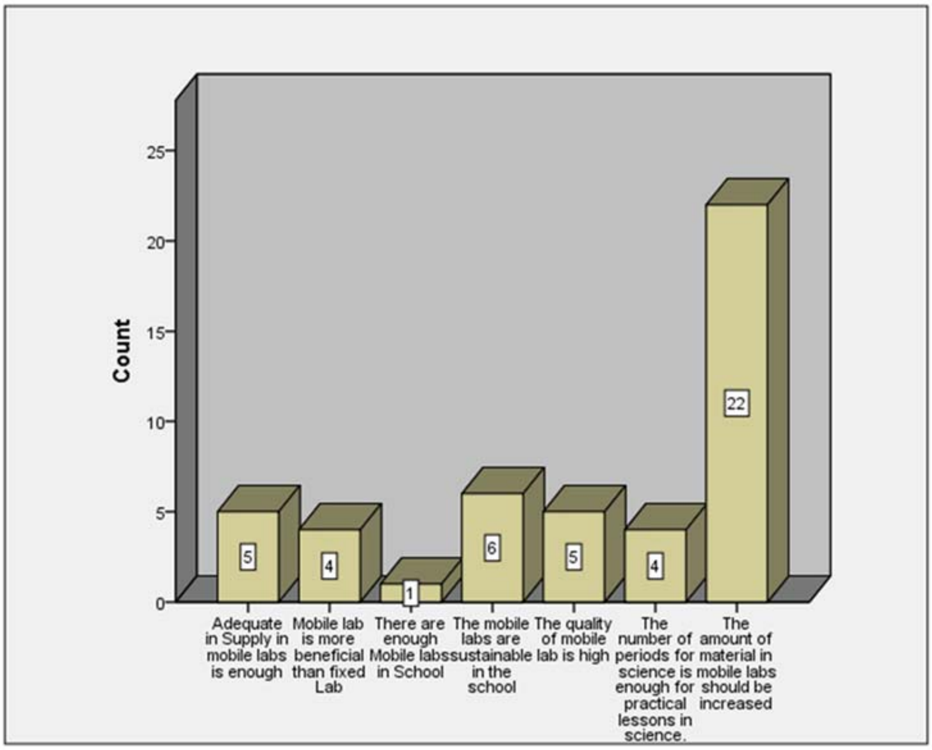
Figure 3: Teachers' Responses on the Quality of Mobile Laboratories in Their Schools



The figure suggests that 18 (or 40%) of the respondents against 17 (or 37.7%) judge the quality of the mobile laboratories available in their schools to be of high quality. However, another nonnegligible percentage of respondents (22.2%) do not see any difference between the bad or good aspect of these laboratories for them to be made the major tool for practical activities in science.

Put together, the main views of teachers on the effectiveness of the mobile laboratories used at their school are summarised using the figure below.

Figure 4: Teachers' Views on the Effectiveness of Mobile Laboratories Used in Schools



The figure shows that of all 45 teachers, 22 believed that the amount of the laboratory material in the mobile laboratories should be increased to suit the size of their classrooms while only 1 of them considered the materials to be enough. Additionally, 4 teachers considered the mobile laboratory to be more beneficial than the classically fixed laboratory, and 6 teachers viewed these laboratories to be sustainable in school.

4.1.2 The Effects of Teachers' Competencies on the Teaching of Integrated Science Practical Lessons in Primary Schools

The teacher's performance could be at the centre of every success in classroom activity. One of the aspects of this performance may be judged in terms of the teacher's attitude to him/herself towards what they do. It is with this that the study tried to find out about the way teachers judge their perception of the use of mobile laboratory in schools and responses were summarised below.

Table 8: Teachers' Judgement of How Good Their Perception Over the Mobile Laboratories

Response	**Frequency**	**Percentage**
Disagree	1	2.2
Neither agree nor disagree	4	8.9
Agree	33	73.3
Strongly agree	7	15.6
Total	**45**	**100.0**

The table suggests that 40 teachers (88.9%) perceive the use of mobile laboratories in a positive way, while 1 teacher does not seem to see the importance of these laboratories in schools.

Table 9: Teachers' Educational Qualification in the Sample Schools

Qualification	**Frequency**	**Percentage**
Certificate	7	15.6
Degree	20	44.4
Diploma	17	37.8
Master's	1	2.2
Total	**45**	**100.0**

Educational qualification may be another factor linked with competence. From the results in the table above, the highest qualification of the science teachers in the sampled schools is master's degree, which was achieved by 1 out of the 45 teachers who participated in the research. Of the 45 teachers sampled, 37 (82.2%) have the medium qualifications which are bachelor's degree and a diploma in education. How these qualifications relate to the use of the mobile laboratories available in school was the question this study sought to answer through research? The attempt to answer the question is presented in the table below.

Table 10: Teachers' Qualifications and their Conversance with the Use of Mobile Laboratories

		Educational Qualification			
		Certificate	Degree	Diploma	Master's
I am very conversant with the use of the mobile laboratory	Strongly disagree	0	1	1	0
	Disagree	1	4	5	0
	Neither agree nor disagree	2	3	4	0
	Agree	4	8	6	1
	Strongly agree	0	4	1	0

A quick scan of the table reveals that 20 out of 38 teachers with qualifications ranging from diploma to master's degree claimed to be at least conversant with the use of mobile laboratories. However, this should be subjected to a statistical test to assess the significance of this assertion.

Table 11: Chi-Square Tests for the Significant Association between Teachers' Qualification and Conversance in the Use of Mobile Laboratories at p< .05

		Educational Qualification
I am very conversant with the use of the mobile laboratory	Chi-square	6.228
	df	12
	Sig.	.904[a,b]

From the table, since the calculated value of 6.228 is greater than the critical value of 5.226, the alternative hypothesis that there is a significant association between the educational qualification and the conversance in the use of the mobile laboratories in the visited schools is accepted and the null hypothesis is rejected.

The teachers' good perception of the mobile laboratories was also tested against the use of mobile laboratories with the analysis of variance and results are as follows:

Table 12: Teachers' Perception of the Mobile Laboratories and Their Use during the Science Lessons

	Sum of Squares	df	Mean Square	F	Sig.	Decision
Between Groups	4.771	3	1.590	2.907	.046	Retain H_0
Within Groups	22.429	41	.547			
Total	27.200	44				

The analysis suggests that there is no significant difference between teachers' perception and the use of the mobile laboratories in their teaching of science. The test of experience against perception reveals the following:

Table 13: Test of Association between Teachers' Experience and Their Perception of Mobile Laboratories Use

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Experience in Teaching Integrated Science is the same across categories of My perception over the mobile lab is good..	Independent-Samples Kruskal-Wallis Test	.292	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

The results show that the teachers' experience does not affect their perception of the mobile laboratories used in their schools. The teaching experience was also verified with the conversance in the use of the mobile laboratories and the results are presented below.

Table 14: Teachers' Experience and Conversance with Laboratory Use Compared

		I am very conversant with the use of the mobile laboratory					Total
		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
Experience in Teaching Integrated Science	0-5 Years	2	5	2	9	4	22
	6-10 Years	0	4	6	8	1	19
	11-15 Years	0	1	1	1	0	3
	21 + Years	0	0	0	1	0	1
Total		2	10	9	19	5	45

The table suggests that the majority of teachers with 10 years of experience and below claimed to be more conversant with the use of mobile laboratories during the science practical lessons than those with 11 years and above. However, this could not be reliable if not subjected to a statistical test, which was run using SPSS and the outcome presented below.

Table 15: Test for Association between the Teachers' Teaching Experience and Their Conversance with the Use of Mobile Laboratories

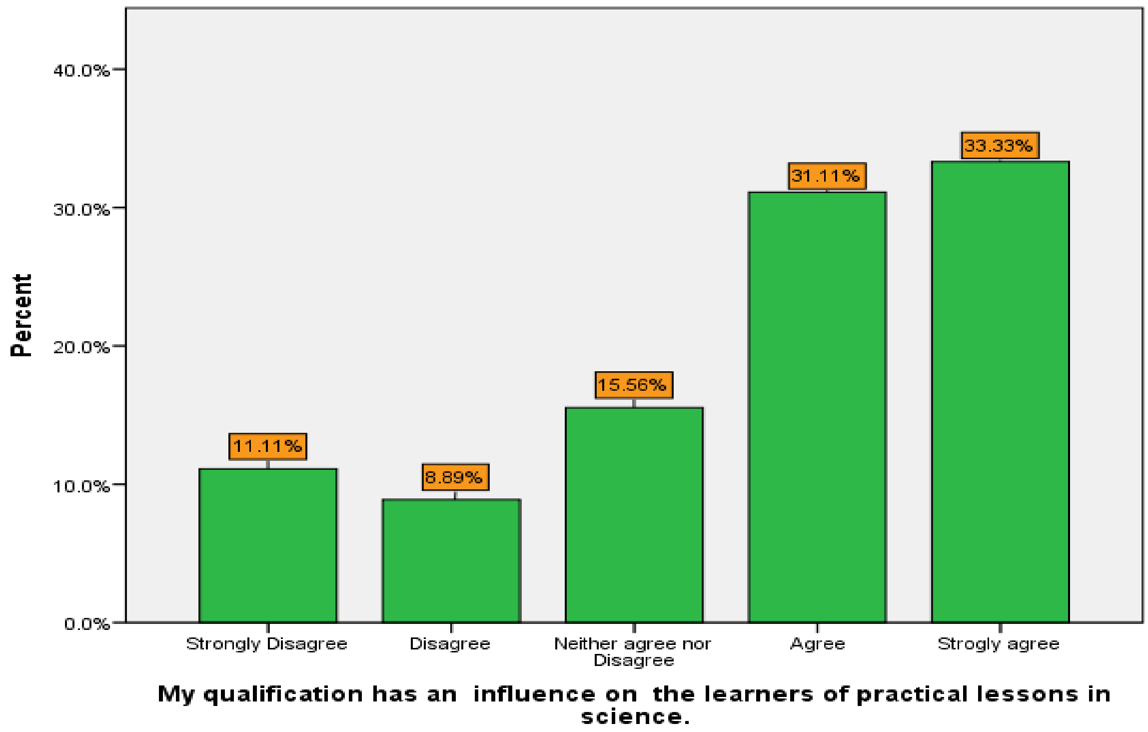
Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Experience in Teaching Integrated Science is the same across categories of I am very conversant with the use of the mobile lab.	Independent-Samples Kruskal-Wallis Test	.201	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

The analysis reveals that the experience does not determine the conversance in the use of mobile laboratories in the sample schools since the null hypothesis was accepted. The research further sought to explore the teachers' views of their qualifications with regard to their influence of the focus of the practical lessons. The results are presented using the figure below.

Figure 5: Teachers' Qualification's Influence on the Learners' Practical Lessons



The summary reveals that 15/45 teachers (33.3%) strongly believe that their qualification really affects their use of laboratories for practical lessons. In general, 29 teachers, constituting 64.4 per cent of all sampled teachers attest to this assertion, against 9 or 20 per cent who held an opposite position to that.

It was also deemed useful to assess the association between the teachers' qualification and the use of demonstration during the Integrated Science lessons and the results from the teachers are tabulated below.

Table 16: Teachers' Qualification and Demonstration during Integrated Science Lessons

		I Demonstrate practical lessons when teaching using a mobile laboratory				Total
		Disagree	Neither agree nor disagree	Agree	Strongly agree	
Educational Qualification	Certificate	0	1	5	1	7
	Degree	2	4	8	6	20
	Diploma	1	3	12	1	17
	Master's	0	0	1	0	1
Total		**3**	**8**	**26**	**8**	**45**

The cross-tabulation does not indicate more about this association, so it was judged more befitting to supplement this with a chi-square statistical test of significance with SPSS.

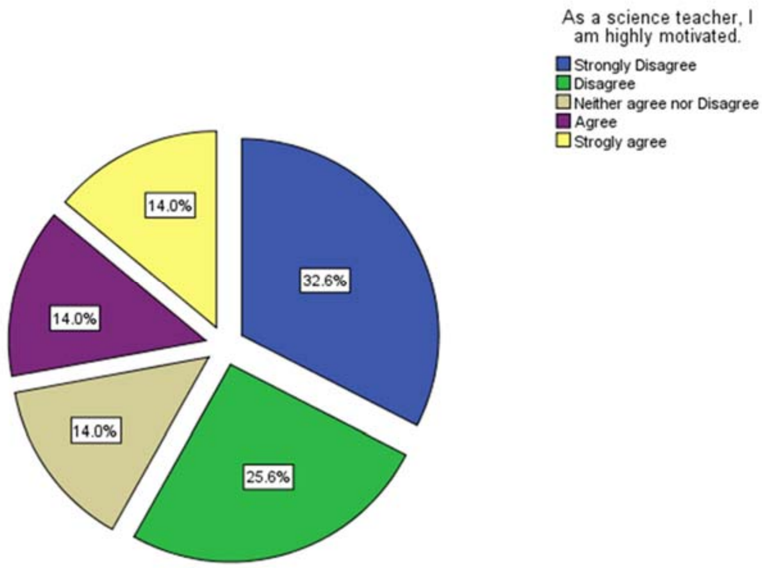
Table 17: Chi-square Test of Significant Association between Teachers' Qualification and Their Use of Demonstration during Science Lessons

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.535[a]	9	.685
Likelihood Ratio	7.602	9	.575
N of Valid Cases	45		

In all cases, H_0 is rejected at the significance level of 0.685, which means that the teacher's qualification is linked with their use of demonstration during the lessons.

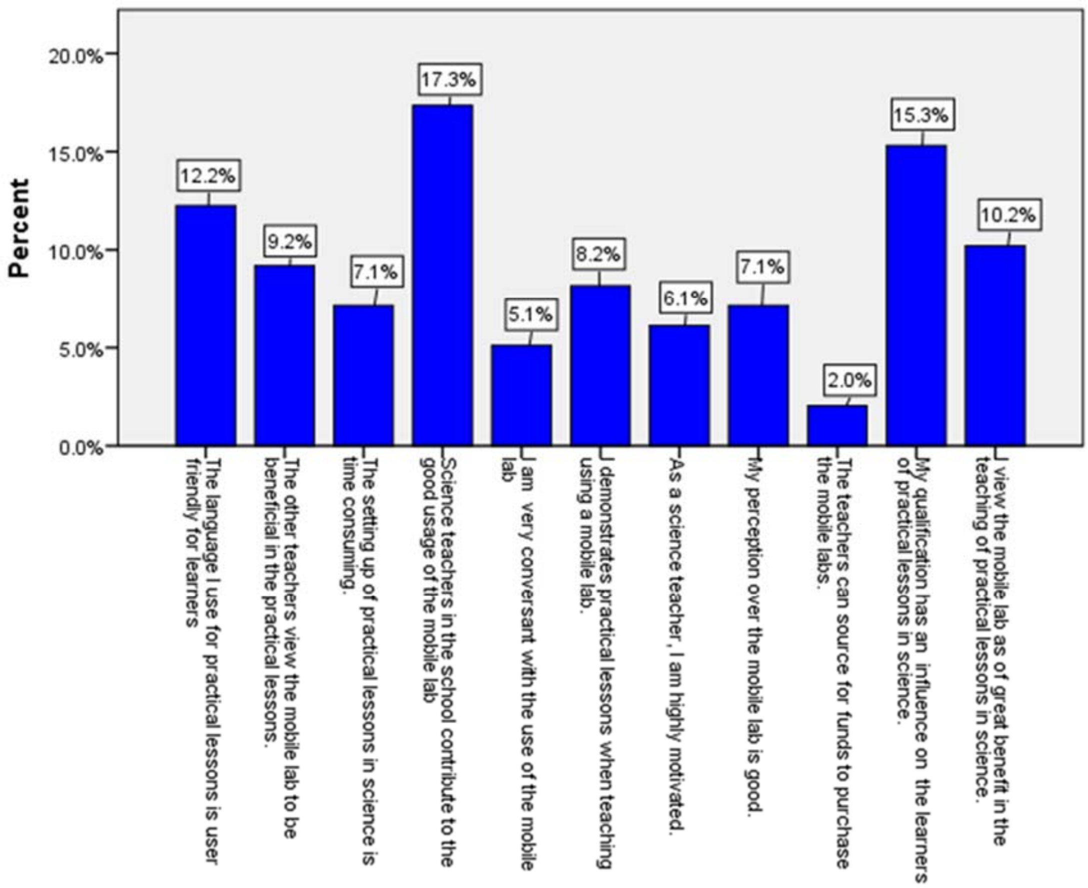
Teacher's motivation could also be another factor of their competence. This is why they were also asked about how they felt motivated teaching Integrated Science.

Figure 6: Teachers' Motivation to Teaching Integrated Science



The results in Figure 6 suggest that only 28 per cent of the teachers feel motivated to teach Integrated Science while 58.2 per cent do not feel motivated to do the job.

Figure 7: Recap of the Teachers' Views of Their Own Competence in the Use of Mobile Laboratories



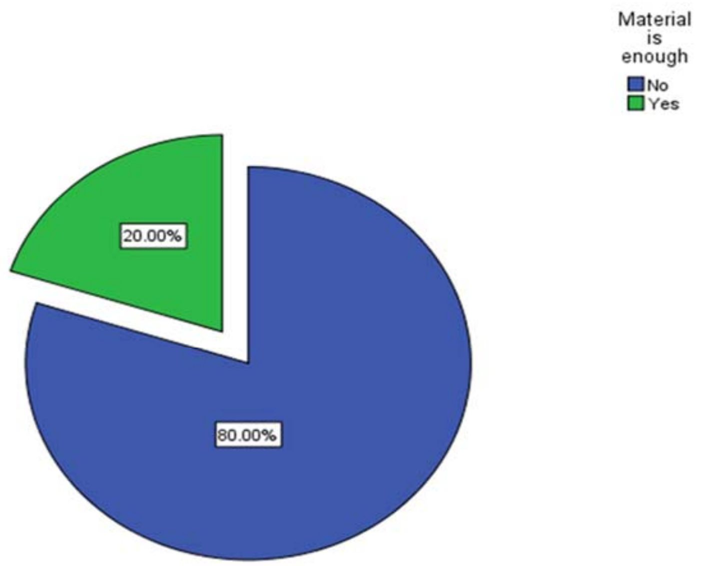
The analysis of the overall teachers' perceptions of the use of mobile laboratories in Integrated Science lessons in schools reveals that generally, the teachers regard these facilities to be very helpful and that their qualification contributes to the good use of the facilities. However, a few of them feel they can source funds to purchase the facilities which they also feel they are not conversant enough with.

4.1.3 The Academic Challenges Faced by Teachers in Teaching Integrated Science Practical Lessons Using Mobile Laboratories

4.1.3.1 Amount of materials available and the state of the mobile laboratories

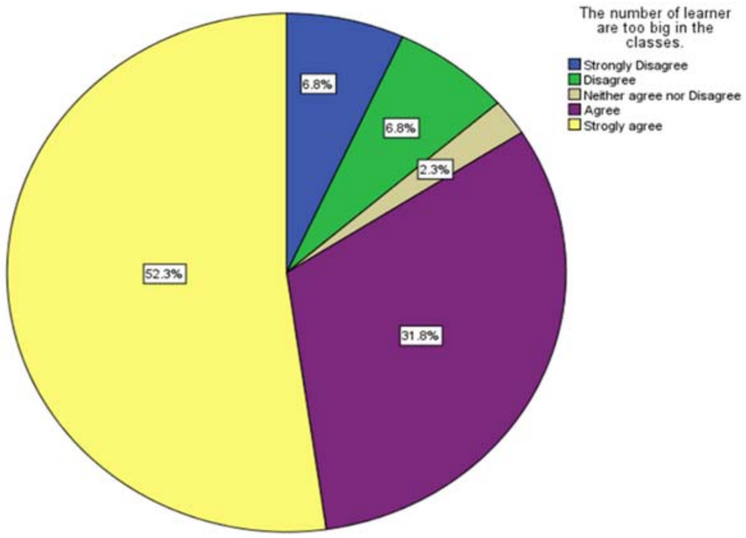
One of the keys to success in practical lessons may be the amount and quality of equipment available for use. It is in this regard that this study first tried to establish the number of laboratory materials that were available in sample schools, and the results are presented in the following figure.

Figure 8: Observation Results of A Number Of Materials in the Mobile Laboratories



From Figure 8 it is clear that the materials for use in mobile laboratories were not enough in 80 per cent of the schools observed. However, being enough or not only depends on the number of learners who need to use the laboratory at the same time. This was one of the complaint by teachers as reflected in Figure 9 below.

Figure 9: Teachers' Responses to Whether the Laboratory's Materials Suited the Number of Learners



The figure shows that 84.1 per cent of the teachers complained about the big number of learners in science classes as compared to the laboratory materials available. Figure 9 also shows that 13.6 per cent of the respondents had no problem with the class size as far as practical lessons were concerned. In addition to these findings, the teachers interviewed also mentioned some challenges related to the laboratories themselves and a number of materials present in the laboratory. Here are just some of their responses:

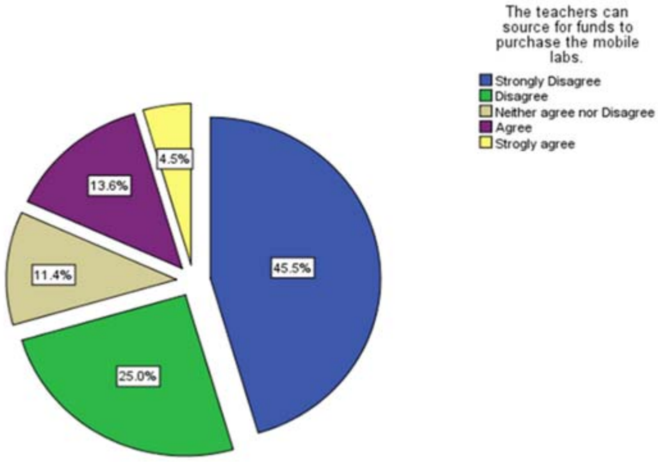
> *"The mobile laboratories are not durable and they have insufficient materials, in short, they are not fully stocked."*
>
> *"Chemicals are very expensive and we don't have enough financial support to buy them as well as other apparatus."*
>
> *"Even the apparatus present are not in good condition and this hinders the frequency of which experiments are done."*

As for the status of the mobile laboratories, the following complaints were raised:

> *"Size of the base room where the mobile laboratories are kept is too small."*
>
> *"More attention is required in assembling a mobile laboratory especially fitting of wheels, some are not mobile due to faulty wheels."*
>
> *"Due to poor passages, it's difficult to move the mobile laboratory due to rough surfaces. Wheels need to be improved."*
>
> *"Some schools do not have permanent rooms to use as a science laboratory."*

More questions on the difficulties related to increasing the number of materials were asked. One of them was about the teachers' action towards resolving the challenge of the shortage of materials and the other was about the role of school administration in providing learning and teaching materials for the laboratories.

Figure 10: Teachers' Responses to Their Ability to Get Laboratories Equipment Funds



The figure shows that the teachers have problems getting new apparatus for the mobile laboratories as proven by 70.5 per cent of the teachers who responded in the negative against 18.1 per cent who agreed that they could source funds for renewal and increase the number of mobile laboratories materials.

Table 18: Teachers' Responses To the Administrative Support in Terms Replacement for Mobile Laboratories

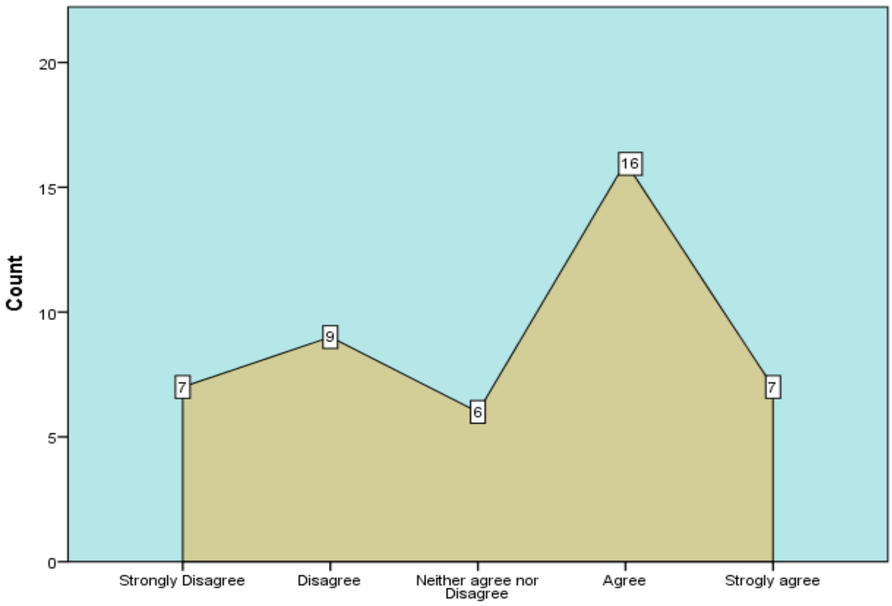
Response		**Frequency**	**Percent**
Valid	Strongly disagree	4	8.9
	Disagree	7	15.6
	Neither agree nor disagree	8	17.8
	Agree	18	40.0
	Strongly agree	7	15.6
	Total	44	97.8
Missing	System	1	2.2
Total		**45**	**100.0**

Despite teachers claiming not to be able to source for funds for purchasing laboratory materials, the majority of them, 25 or 55.6 per cent affirm that their administrations are always ready to release funds to replace the used materials.

4.1.3.2 Time management disadvantage

The teachers' feeling about the preparatory procedure of the practical lesson, may also constitute a hindrance to the performance of the scientific experiment.

Figure 11: Teachers' Response to Whether the Apparatus Setup Process is Time-Consuming



From the figure above, the majority of teachers (23/45) regard the setting up process of the laboratory apparatus for the experiments or demonstrations to take too much of the time allotted for the lesson.

From the results presented above, the majority of the teacher respondents agreed that there are a number of challenges over the use of mobile laboratories in schools. In addition to what has just been presented, the teachers interviewed mentioned more difficulties encountered while teaching Integrated Science using these facilities. Some are presented below:

> *"Some topics which are in Integrated Science have no apparatus in the mobile laboratories."*
>
> *"The background knowledge about the mobile laboratory by the teachers pose a big challenge in the teaching of science practically."*

““The number of mobile laboratories is inadequate as the classroom are highly spaced and this results into some pupils not clearly observing or fully participating in the practical lesson.”

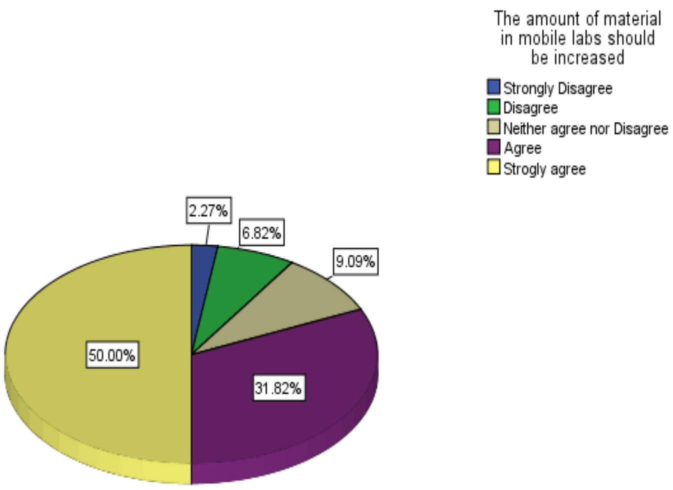
“No, sufficient security for space is not enough to accommodate all the learners.”

“Teachers are not properly oriented on the use of mobile laboratories and its contents. There should be orientation before mobile laboratories are distributed in schools.”

Nonetheless, not only were the challenges presented, some suggestions were made for improvement by the teachers interviewed.

4.1.3.4 Suggestions for change

Figure 12: Views of Teacher on the Increment of the Laboratory Materials



As the figure suggests, the teachers feel that the mobile laboratory materials should be increased to suit the number of learners who need to use them at the same time, as highlighted by 81.82 per cent of the respondents. Apart from the individual materials in the laboratories, according to the teachers, even the number of the mobile laboratories supplied to the schools should be risen as more shared the similar view to this: *“Supply more laboratories for academic excellence”, “The room where the practical lessons are conducted should also be increased”, “Rooms should be made large enough to accommodate mobile laboratories that can match with the number of learners.”*

4.2 Chapter Summary

This chapter has covered presentations of the findings of the study on the views of the science teachers who are using these mobile laboratories to teach practical lessons from selected primary schools of Northern and Eastern Provinces of Zambia. The data was presented according to the themes in the instruments and in line with the objectives and questions of the research. Three main themes deduced from the objectives, namely; the effectiveness of mobile laboratories in teaching of Integrated Science practical lessons in primary schools, the effects of teachers' competencies on the teaching of Integrated Science practical lessons in primary schools as well as the academic challenges faced by teachers in teaching Integrated Science practical lessons using mobile laboratories, were developed.

CHAPTER FIVE
DISCUSSION OF FINDINGS

5.0 Introduction

This chapter discusses the research findings based on the purpose of the study which is to explore teachers' views on using mobile laboratories when teaching Integrated Science during science practical lessons; to assess the teachers' competence in using the mobile laboratories and to establish the challenges they face in this practice.

5.1 Demographic Profile of Respondents

Province	District	Respondents	Total
Eastern	Chipata	12	12
	Katete	4	4
	Nyimba	4	4
	Petauke	3	3
Northern	Kasama	11	11
	Luwingu	4	4
	Lunte	4	4
	Mungwi	3	3
			45

5.1.1 The effectiveness of mobile laboratories in teaching of Integrated Science practical lessons in primary schools

In accordance with an observation by Muzumara (2008), the distribution of Mobile Laboratories to different provinces of the country in normally meant to boost the teaching of the practical aspects of Integrated Science in a bid to improve the learners' performance, as well as the teachers' enthusiasm in teaching the subject. However, to achieve their purpose, it is important that the quality of these materials be taken into consideration before they are supplied to the various schools. It is for this same reason that this study sought to establish the level of effectiveness of the mobile laboratories available in schools. The results from the teachers who participated in the study indicated that the material present in their schools were of good quality, but 55.8 per cent of the respondents considered the supply in the materials not to be adequate. This judgement was based on the fact that the proportion of these materials to the number of learners or simply the class size was unbalanced.

The inadequacy of the teaching materials in terms of their numbers as compared to the class size was viewed by Belington (2012) as disadvantaging the effectiveness of the teaching of science in the sense that it hinders the extra attention by the teachers to the learners, which is one of the most important practices in the teaching-learning process.

Despite this challenge on the amount of the materials, the majority of teachers, 37.8 per felt satisfied with the quality of the materials supplied to their schools for the teaching and learning purpose. These findings relate to the observation by Suttan *et al.,* (2008) that teaching through practical activities helps engage learners to develop relevant aptitudes to the life skills and promotes eagerness to discover more elements of scientific knowledge. The point is also shared by Tsipa *et al.,* (2010), who through their research findings on the impact of mobile science laboratories in the performance of Grade 12 learners in the Mpumalanga Province of South Africa, established that pupils learnt more efficiently when exposed to stimulating environments such as the laboratory, which they regarded as a propeller of the proper learning process. Although the numbers of tools available are not enough, as compared to the size of classrooms, the teachers explained that they countered this challenge by getting the learners to work in groups which also promotes the social interaction and peer teaching. This was also confirmed by the researcher's direct observation during the practical lessons, as the interaction was found to be more pronounced than in the ordinary classes.

Another point worth considering, which is likely to bridge the gap of the shortage in laboratory materials, was mentioned by Clark (2009), articulating that the key advantage of a mobile science laboratory is that one set of equipment can be used to serve multiple schools. However, despite its worth consideration as the whole essence of the use of mobile laboratories, this point was hardly emphasised in this study but its further exploration is suggested for future studies on the similar topic.

5.1.2 The effects of teachers' competencies on the teaching of Integrated Science practical lessons in primary schools

The teachers' performance in teaching the practical science was also considered by this study. This was first looked at in terms of the teachers' attitude towards the practice itself and the materials used in the teaching-learning process. The analysis of results revealed that the majority of teachers regarded the use of the mobile laboratories for teaching science in an optimistic way. This could mean that the teachers were highly encouraged to teach the Integrated Science subject using the laboratory materials found in the mobile laboratories in their schools.

However, it was proved statistically that the teachers' perception towards the use of the mobile laboratories has nothing to do with the practice itself. This means that considering their attitude could not be solely relied on in judging their motivation in using these materials.

Another variable susceptible of being related to the teaching of science practically was teachers' qualification. On the course of this study, the teachers' qualification was statistically demonstrated to be linked with the conversance in the teaching of science using the adequate laboratory materials. This was further approved by teachers themselves, for a good percentage of (64.4%) they agreed to the fact that their qualification affected their use of science laboratories in the practical lessons. About 33.3 per cent of the sample were also of the view that teacher's qualification had an effect. Furthermore, the teachers' qualification was statistically proved to affect the use of demonstration during the science lessons. This means that highly qualified teachers are most likely to effectively or venture into the use of demonstration while teaching Integrated Science subject.

Another factor which was suspected to affect the use of the mobile laboratories in science practical activities was the teachers' experience. The majority of the teachers with higher teaching experience claimed not to be conversant with the use of the laboratory materials in their teaching activities. However, it was statistically proven that there was no significant association between the two, as the hypothesis stating that "the distribution of experience in the teaching of Integrated Science is the same across categories of conversance with the use of the mobile laboratories," was rejected.

Teachers' motivation was also taken into consideration in this study but from the teachers' point of view. It was established in the study that the majority of the teachers (58.2%) felt not motivated to do the job of teaching science. In the views of Santrock (2008) and Shunk, (2009), motivation strengthens, guides, instigates and sustains goal directed behaviour. This simply means that motivation is more like a vehicle that drives one to achieve their goals. In this regard, regardless of the qualification, attitude or perception, teachers' competencies in the use of the mobile laboratory materials to teach practical science lessons are likely to be misjudged, as long as their motivation to do so is not really taken care of.

5.1.3 The academic challenges faced by teachers in teaching Integrated Science practical lessons using mobile laboratories

The challenges hindering the normal teaching of Integrated Science lessons using the mobile laboratories were deemed important to investigate in this research. The first aspect of the problems which was considered was the amount of laboratory materials and equipment available in schools. This was found not to be sufficient in 80 per cent of the schools observed. However, the not to be ignored 20 per cent of the schools suffer a shortage of these materials.

Although the number of materials was found to be in good number in most schools, the complaint about the shortage of laboratory requirements was voiced by teachers, with 84.1 per cent lamenting of not having a suitable amount of materials considering the class size they had to deal with at the same time. Overcrowded classes, as a hindering factor to the use of mobile laboratories, was also noted by Abruscato, (2009). The main consequence of this is the deprivation of learners of their chance to manipulate these materials and benefit from the advantages of the hands-on methods more beneficial in science lessons.

Room size where the apparatus is operated from was echoed by some teachers as one of the challenges and is supported by Belington (2012) who added that when classes are overcrowded and laboratory space is limited, learners fail to benefit from classroom instructions. As a result, the attention of learners is highly limited, and this is likely to hinder the aptitudes such as scientific creativity and critical analysis which is crucial as far as the goals of learning and teaching science are concerned.

Not only that, in another perspective, not away from this, Clark (2009) observed that the process of teaching science using the laboratories is usually made difficult by the fact that the access to equipment and supplies are difficult for most schools to acquire and maintain. The researcher has observed that a number of schools had no space where to put mobile labs. This makes the teaching of practical lesson difficult as affirmed by Millar (2008). On the other hand some teachers in this study complained of irregular supply of laboratory materials which is usually as result of high price of these materials and the schools do not stand economically comfortable enough to afford the cost. This also results in some schools resorting to buying low-quality cheap materials which either do not last long or do not work effectively to fulfil their experimental need. Additionally planning becomes a challenge as a result learners are not given the appropriate scientific investigation activities.

The apparatus setup, which does not only require space also demands time to be ready for use. This poses yet another challenge to teaching practical science lessons in the laboratories. It was brought to the researcher's attention by 23 out of sampled 45 teachers interviewed that setting up process of the apparatus is part of lesson preparation. This, they noted is time-consuming, and leads some to giving up the procedure and resorting to a theoretical explanation without demonstration during the teaching-learning process. This learning of science theoretically according to Abruscato (2009), poses a very big danger as the practice denies learners of the hands-on practical aspect which negatively affects the learning of science and besides, this puts the teachers' skills at teaching such a pupil to the test. This can be explained by the fact that some of the most important aims of learning Integrated Science in schools could be compromised by going theoretical rather than practical as discovery is given no way in this.

5.2 Chapter Summary

This chapter has covered the discussion of the findings of the study. The findings were that the quality of materials in these laboratories is quite good but the numbers of these materials are not in line with the size of the classes. The findings further revealed that a number of factors contributed towards the teachers' competence in the use of mobile laboratories. However, the findings showed correlation between qualification and competence in the use of mobile laboratory by the teachers. The higher the qualification the more the competence in the use of mobile laboratories apparatus. Additionally the findings revealed that the use of these laboratories increases the motivation of learners, allows the exploration of some active teaching methods such as hands-on, peer teaching and make learners to participate actively in the teaching-learning process. Furthermore the findings alluded to a number of challenges faced by teachers on the use of mobile laboratories. It was revealed that the amount of the materials in these laboratories is generally not enough as compared to the size of the classes. On the other hand the financial constraints in schools poses a challenge in terms of restocking the mobile laboratories. On the other hand the findings indicated that teachers required to be orientated in the use of these laboratories.

CHAPTER SIX
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

This chapter outlines the summary of the research questions, the conclusion about the research and some recommendations are made based on the research findings. Further, the future research areas based on the present research findings are proposed.

6.1 Summary of Findings

6.1.1 Research question 1: What are the teachers' views on the effectiveness of mobile laboratories in the teaching of Integrated Science practical lessons in selected primary schools?

With regard to the effectiveness of the mobile laboratories available in schools, it was found that the quality of the materials in these laboratories is quite good but the numbers of these materials are not in line with the size of the classes. This affects the teaching and learning process in a negative way. However, in the few schools where the quality and amount of materials are sufficient, the use of these laboratories is able to increase the motivation of learners, to allow the exploration of some active teaching methods such as hands-on, peer teaching and to make learners participate actively in the teaching-learning process.

6.1.2 Research question 2: What effects do teacher competencies have on the teaching of Integrated Science practical lessons in selected primary schools?

Concerning the effects of teachers' competencies in the use mobile laboratory materials in the teaching and learning process, it was found that this is dependent on various factors. One of the factors was the teachers' attitudes and perceptions towards the use of the laboratories. Although attitude and perception were recorded as factors, it was found that these aspects did not affect the practice in a significant way.

Another factor was the teachers' qualification, which was found to be associated with their competence in the use of mobile laboratory; that is the higher the qualification the more the competence in the use of mobile laboratories apparatus. It was found that qualification and not experience had an effect on the competence of the teacher to use the mobile laboratory. Experience, it was found, has nothing to do with this competence. This means that the qualification is enough for the teachers to be able to effectively use the laboratory materials available in schools. The highly qualified teachers, according to the study are also most likely to include a demonstration in their teaching of Integrated Science in their activities.

6.1.3 Research question 3: What academic challenges do teachers face in teaching science practical lessons using the mobile laboratory in Integrated Science?

In terms of challenges faced by teachers over the use of mobile laboratories, it was found that the amount of the material in these laboratories is generally not enough as compared to the size of classes. Besides this, the schools are not financially strong to replenish them after they are used up. The mobility of the equipment was also questioned as the teachers indicated that the laboratories were not so easy to move from one place to another because of faulty wheels. Furthermore, some teachers find it time-consuming to prepare and set up these apparatus for experiments. Additionally, teachers need some orientation on the use of these laboratories

6.2 Implications of the Findings

The teaching of science globally expects the learners to be actively involved and this can only be attained through practical work. This has an important role in science education (Hodson, 1993; Hofstein and Lunetta, 2004); The meaning of practical work in this study is close to Hodson's(1993), which includes any activity that requires learners to be active, more directly involved in scientific research, such as observing, formulating problems and hypotheses, controlling variables and predicting (Duschl, Schweingruber and Shouse, 2007).This helps the learners to see science in action through the various activities that they carry out. Many research studies have emphasised that for many teachers, practical work means simple recipe-type activities that students follow without the necessary mental engagement.

The 2013 Curriculum Frame of Zambia points out that teachers must use the laboratory to reinforce their teaching by providing learners with hands on experiences which focus on the acquisition of skills such as observing controlling variables, recording, measuring, manipulating apparatus and chemicals and following procedural instructions. These skills are considered as a way of thinking when teachers implement practical activities particularly, laboratory work.

Based on the evidence gained from this study, practical work helps learners to develop their understanding of science and appreciate that science which is based on evidence. Consequently, in the long-run, they acquire hands on skills that are essential for their progression. In addition, the findings from this study bring to light the effectiveness of the mobile laboratory available in schools. These allow the exploration of active learning methods such as hands-on, peer teaching, and they make learners participate actively in the teaching-learning process. Additionally, teachers' competencies in the use of the mobile laboratories is dependent on their qualifications. This calls for more training for science teachers and this is evidence by Millar's study (2008) which points out that science teachers need to be fully qualified to develop new knowledge and ways that learners come to understand from their immediate environment. Mzumara , (2008) echoes the same sentiment by stressing that the most common need for the primary school teachers is to broaden their science subject knowledge if they are to teach the subject effectively and confidently while secondary school teachers are urged to go for in-service training which should be centred on updating and improving science teaching methods as well as familisation with changes in the National Curriculum.

Furthermore, teachers need to be motivated to use the available mobile laboratory, starting by improving the number of materials present in the laboratories. According to the results of the study, both teachers' and learners' interaction is cardinal to enhance the principles of constructivism.

Despite a number of challengers in teaching practical lessons in Science, this study calls for the government to provide more laboratory materials as well organise more short courses aiming at improving science teachers' knowledge and skills in the use of mobile laboratory facilities. In summary, Zambia needs the production of mobile laboratories to cater for the conventional ones so as to enhance the teaching of practical lessons. This will not only revamp the necessary conditions for enriching teachers' knowledge of inquiry but it will avail learners the necessary exposure to attain scientific knowledge and skills.

6.3 Conclusions

With regard to the effectiveness of the mobile laboratories available in schools, it can be concluded that the quality of materials in these laboratories is quite good but the numbers of these materials are not in line with the size of the classes. This affects the teaching and learning process in a negative way. However, in the few schools where the quality and amount of materials are sufficient, the use of these laboratories increases the motivation of learners, allows the exploration of some active teaching methods such as hands-on, peer teaching and make learners to participate actively in the teaching-learning process.

As for the teacher's competence in the use of the mobile laboratory materials in the teaching and learning process, it was found that various factors contributed. One of the factors was the teachers' attitude toward the use of the laboratories and perception towards the use of these facilities. It was found that attitude and perception do not affect practice in a significant way. Another factor was the teachers' qualification, which was found to be associated with their competence in the use of mobile laboratory; that is the higher the qualification the more the competence in the use of mobile laboratories apparatus. It was found that qualification, and not experience had an effect on the competence of the teacher to use the mobile laboratory. Experience, it was found, has nothing to do with this competence. This means that the qualification is enough for the teachers to be able to effectively use the laboratory materials available in schools. The highly qualified teachers, according to the study are also most likely to include a demonstration in their teaching of Integrated Science in their activities.

In terms of challenges faced by teachers on the use of mobile laboratories, it was found that the amount of the materials in these laboratories is generally not enough as compared to the size of the classes. Besides, the schools are not financially strong to replenish the laboratories after they are used up. The physical state of the equipment in terms of mobility was also put to question as they are not so easy to move from one place to another as result of some faulty wheels. Furthermore, some teachers find it time-consuming to prepare and set up such apparatus for experiments. Additionally, some teachers need to be orientated in the use of these laboratories.

6.4 Recommendations

Based on the findings of the study, the following are some of the recommendations which were made and addressed to different education stakeholders for improvement.

6.4.1 To the Ministry of General Education

The Ministry of General Education needs to:

i) Provide more laboratory materials and monitor the level of usage of these materials.
ii) Look into the fact that graduating teachers from colleges and universities should be able to handle the mobile laboratory facilities.
iii) Organise more short courses aiming at improving science teachers' knowledge and skills of the use of mobile laboratory facilities.
iv) Number of mobile laboratories to be able to accommodate the big number of pupils in the classes.

6.4.2 To Junior Secondary Schools

The Junior Secondary Schools should:

i) Find all means possible to increase teachers' motivation to use the available mobile laboratory. This should start by improving the condition and the number/amount of materials available in the laboratories.

6.4.3 To the Future Researchers

There is need for future researchers to:

- Explore topics related to:
  - (a) Usability of mobile laboratories in multiple schools.
  - (b) Teachers' motivation as a factor of promotion of the use of laboratory experiment in teaching Integrated Science lessons

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APPENDICES

Appendix A: Proof of Registration

UNISA university of south africa

1036 M1RST

CHILANDO G MS
ZAMISE COLLEGE
P O BOX 320081
LUSAKA
10101
ZAMBIA

STUDENT NUMBER : 5324-508-3

ENQUIRIES NAME : POSTGRADUATE QUALIFICATIONS
ENQUIRIES TEL : (012) 441-5702

DATE : 2017-04-19

Dear Student

I wish to inform you that your registration has been accepted for the academic year indicated below. Kindly activate your Unisa mylife (https://myunisa.ac.za/portal) account for future communication purposes and access to research resources. Please check the information below and kindly inform the Master's and doctoral section on mandd@unisa.ac.za on any omissions or errors.

DEGREE :	MED (SP IN NATURAL SC EDU) (98448)
TITLE :	Teaching practical lessons using mobile laboratory: A case of selected Basic schools in Zambia
SUPERVISOR :	Dr HO MOKIWA
ACADEMIC YEAR :	2017
TYPE:	LIMITED SCOPE
SUBJECTS REGISTERED:	DFNSE95 MED - NATURAL SCIENCE EDUCATION (DISSERTATION)

A statement of account will be sent to you shortly.

If you intend submitting your dissertation/thesis for examination, complete form DSAR20 (Notice of Intention to Submit) before 30 September. If this deadline is not met, you need to re-register and submit your intention for submission by 15 April and submit your dissertation by 15 June.

Your supervisor's written consent for submission must accompany your notice of intention to submit.

Yours faithfully,

Prof QM Temane
Registrar (Acting)

University of South Africa

Appendix B: Questionnaire for Teachers

Actual Research Instrument

Dear respondent

This questionnaire forms part of my master's research entitled: '**Teaching Practical Lessons Using Mobile Laboratory: A Case of Selected Basic Schools in Zambia'** for the degree of MEd at the University of South Africa. You have been selected by a random sampling strategy from the population of fifty (50). Hence, I invite you to take part in this survey.

The aim of this study is to investigate **teaching of practical lessons using the mobile laboratory**. The findings of the study will benefit a number of researchers worldwide who may have the interest to build on the knowledge attained about the teaching of practical lessons using Mobile Laboratories. Additionally, science teachers in Zambia will be enlightened on a number of aspects in relation to the Mobile Laboratory which may result in improved classroom performance.

You are kindly requested to complete this survey questionnaire, comprising two sections as honestly and frankly as possible and according to your personal views and experience. No foreseeable risks are associated with the completion of the questionnaire which is for research purposes only. The questionnaire will take approximately thirty (30) minutes to complete.

You are not required to indicate your name or organisation and your anonymity will be ensured; however, an indication of your age, gender, occupation, position etcetera will contribute to a more comprehensive analysis. All information obtained from this questionnaire will be used for research purposes only and will remain confidential. Your participation in this survey is voluntary and you have the right to omit any question if so desired, or to withdraw from answering this survey without penalty at any stage. After the completion of the study, an electronic summary of the findings of the research will be made available to you on request.

Permission to undertake this survey has been granted by the Zambian Ministry of Education and the Ethics Committee of the College of Education, UNISA.

If you have any research-related enquiries, they can be addressed directly to me or my supervisor.

My contact details are: 0977708709 e-mail: gchisanga5@gmail.com
My supervisor can be reached at +27-124296562, Department of Science and Technology, College of Education, UNISA, e-mail: mokiwho@unisa.ac.za

By completing the questionnaire, you imply that you have agreed to participate in this research.

Please return the completed questionnaire to Ms. Chilando Grace before 30th May 2016

Tick the option [ ] and give an explanation in the spaces provided

SECTION A

1. Province……………………………………………………………………….
2. District ………………………………………………………………………..
3. School ………………………………………………………………………..
4. Gender: Female [ ] Male [ ]
5. Age :

   25 and below [ ]

   26- 35 [ ]

   36- 45 [ ]

   46 and above [ ]

6. Educational qualification

   Primary Certificate [ ]

   First Degree [ ]

   Masters [ ]

   Others

   Specify…………………………………………………………………………………
   ……………………………………

7. How many years have you worked in the Ministry of Education?

   05 and below [ ]

   6- 10 [ ]

   11- 15 [ ]

16 -20 [ ]

21 and above [ ]

8. How many years have you been teaching Integrated Science?

05 and below [ ]

6- 10 [ ]

11- 15 [ ]

16 -20 [ ]

21 and above [ ]

SECTION B

In pursuance of challenges teachers encounter when using a Mobile Laboratory in the teaching of Science Practical Lessons, indicate to what extent the following factors could be responsible. Circle a number on the Likert scale of 1-5 to indicate your agreement or disagreement

KEY

5- Strongly Agree (SA)

4- Agree (A)

3- Neither Agree or Disagree (N)

2- Disagree (D)

1- Strongly Disagree (SD)

Situations/ factors that contribute to teachers' not teaching practical science using a mobile.

#	ITEMS	1 SD	2 D	3 N	4 A	5 SA
1	The supply of mobile laboratories in schools is adequate	1	2	3	4	5
2	The number of mobile laboratories in the school is enough.	1	2	3	4	5
3	The mobile laboratory is more beneficial in comparison to permanent laboratories	1	2	3	4	5
4	The quality of materials in the mobile laboratory are of high quality	1	2	3	4	5

5	The volume of the materials in mobile laboratories should be increased.	1	2	3	4	5
6	The mobile laboratories are sustainable in the school.	1	2	3	4	5
7	The number of periods for science is enough for practical lessons in science.	1	2	3	4	5
8	I am very conversant with the use of the mobile laboratory.	1	2	3	4	5
9	I view the mobile laboratory as of great benefit in the teaching of practical lessons in science.	1	2	3	4	5
10	I demonstrate practical lessons when teaching using a mobile laboratory.	1	2	3	4	5
11	The setting up of practical lessons in science is time-consuming.	1	2	3	4	5
12	The language I use for practical lessons is user-friendly for learners.	1	2	3	4	5
13	As a science teacher, I am highly motivated.	1	2	3	4	5
14	My perception over the mobile laboratory is good.	1	2	3	4	5
15	My qualification has an influence on the learners of practical lessons in science.	1	2	3	4	5
16	Science teachers in the school contribute to the good usage of the mobile laboratory.	1	2	3	4	5
16	The teachers can source for funds to purchase the mobile laboratories.	1	2	3	4	5
17	The non-science teachers view the mobile laboratory to be beneficial in the teaching of practical lessons in science.	1	2	3	4	5
18	The number of learners are too big in the classes.	1	2	3	4	5
19	I demonstrates the practical lessons to the learners.	1	2	3	4	5

20	The pupils can set up the experiments on their own without the help of the teacher.	1	2	3	4	5
21	The pupils have no sound background in science.	1	2	3	4	5
22	The pupils are safe during the use of the mobile laboratory.	1	2	3	4	5
23	The attitude of pupils towards the practical lessons in science is encouraging.	1	2	3	4	5
24	The pupils put the items in the mobile laboratory properly after use.	1	2	3	4	5
25	The administration is supportive in terms replacement for mobile laboratories.	1	2	3	4	5

What other factors other than these mentioned above pose as challenges to the science teachers in the teaching of practical lessons using a mobile laboratory?

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

Appendix C: Observation Schedule

Introduction

This instrument is to be completed during observation of classroom instruction. Prior to instruction, the observer will review planning for the lesson with the instructor.
During the lesson, the observer will write an anecdotal narrative describing the lesson and then complete this instrument.
Date of observation: ___________________
Start time: ___________________________
End time: ___________________________

Section A: Biographic information

- What is your gender? ______________
- What is your age? _________________
- What is your teaching experience in years? ______________
- What is your highest qualification? _____________________
- What is your teaching workload per week? __________________
- What is your average number of learners in your STEM class? _____________

Observation schedule:

NO	ITEMS	Detailed explanation based on the observation
1.	The materials in the mobile laboratory are enough.	
2.	Introduction of the lesson is mind capturing.	
3.	The number of learners is manageable.	
4.	Language used is user-friendly.	
5.	Learner participation is full.	

6.	Lesson is teacher centred.	
7.	Teacher demonstrated the lesson.	
8	Group work used to demonstrate the lesson.	
9.	Learners working in manageable groups.	
10.	The learners were safe during the lesson.	

Appendix D: Interview Schedule

Research Topic: Teaching Practical Lessons Using Mobile Laboratory: A case of selected Basic Schools in Zambia

UNISA/College of Education

I am a Master's student doing Masters of Education in Natural Science in the School of Natural Science and Technology carrying out a Research on '**Teaching Practical Lessons Using Mobile Laboratory: A case of selected Basic schools in Zambia'.** The information that will be collected from you is purely for academic purposes only and will be used as such. Please kindly answer this questionnaire as sincerely as you can. Thank you.

The interview should take about 30 to 60 minutes.

Interview Guide

1. What is your view as a science teacher on the mobile laboratory for science practical lessons?
2. How are lessons taught using mobile laboratories?
3. What is the role of the mobile laboratory in the teaching of practical lessons in science?
4. What are the views of school management towards the mobile laboratory in the teaching of practical lessons in science?
5. What are the views of parents towards the mobile laboratory in the teaching of practical lessons in science?
6. What are the views of non-science teachers towards the mobile laboratory in the teaching of practical lessons in science?
7. How safe are the pupils during the use of the mobile laboratory?
8. How does a number of science teachers in the school contribute to the good usage of the mobile laboratory?
9. How do teachers/school to acquire the mobile laboratories?
10. How does language of teaching and learning impact on the understanding of practical lessons?

11. How are the learners involved during the practical lesson in science?

12. Any other information?

Appendix E: Letter to the Head teacher

4.6 Request for permission to conduct research at ……………………………………..

TITLE: 'Teaching Practical lessons in Integrated Science Using Mobile Laboratories: A case of selected basic schools in Zambia.'

29th January, 2016

The Head teacher,

…………………………………….

……………………………………

……………………………………

Dear……………………………………….

I, Chilando Grace, am doing research with Dr H.O. Mokiwa, a Senior Lecturer in the Department of Science and Technology Education towards a Master's Degree at the University of South Africa. The researcher is self-sponsored. We are inviting you to participate in a study entitled, '**Teaching Practical Lessons in Integrated Science Using Mobile Laboratories: A case of selected basic schools in Zambia.'**

The aim of the study is to establish the challenges faced by teachers when teaching practical lessons using a mobile laboratory.

Your school has been selected because statistics from GRZ (2006) indicates that your school is among those that have been supplied with the highest number of mobile laboratories in Zambia

The study will entail finding out from the science teachers what challenges they face in teaching a practical lesson using mobile laboratories. This will be in terms of exploring the materials used, teachers' competencies and the pedagogy being employed.

The benefits of this study are that people at the National Science Centre may come up with innovations on the mobile laboratory which will enhance the teaching and learning of Practical lessons in Integrated Science in Primary schools.

However, potential risks will be encountered in terms of some participants not finding time to answer the questionnaire which will put the researcher at the risk of not having adequate data. On the other hand, the researcher may miss out on some important points that are not included in the formulated questions, (Kombo and Tromp, 2008:95).

Feedback procedure will entail the participants being phoned, e-mailed and distributing the dissertation to district resource centres so that a number of teachers can have access to the document and utilise it in their areas of need and particularly, those who would anticipate researching on the same topic in future.

Yours sincerely

Chilando Grace

Head of Section

Appendix F: Consent

CONSENT TO PARTICIPATE IN THIS STUDY (Return slip)

I, ……, confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interview.

I have received a signed copy of the informed consent agreement.

Participant Name & Surname: ………………….

____

Participant Signature Date

Researcher's Name & Surname: …………………

____

Researcher's signature Date

Appendix G: Letter for the Participant

EXAMPLE OF A LETTER REQUESTING AN ADULT TO PARTICIPATE IN AN INTERVIEW

Dear ………………

This letter is an invitation to consider participating in a study I, **Chilando Grace** is conducting as part of my research as a Master's student entitled **'Teaching Practical lessons in Integrated Science using Mobile Laboratories: A case of selected basic schools in Zambia,'** at the University of South Africa. Permission for the study has been given by the Science and Technology Education and the Ethics Committee of the College of Education, UNISA. I have purposefully identified you as a possible participant because of your valuable experience and expertise related to my research topic.

I would like to provide you with more information about this project and what your involvement would entail should you agree to take part. The importance of practical lessons in the learning of Science in education is substantial and the information gathered by the researcher will be well documented. The data collected will be critical in this research to support the National Science Centre on the innovations which can be employed on the Mobile Laboratories as a way of enhancing the teaching of Practical lessons in Integrated Science in Primary schools.

In this interview, I would like to have your views and opinions on this topic. This information can be used to improve the teaching of practical lessons in Integrated Science as a number of teachers have challenges in this area.

Your participation in this study is voluntary. It will involve an interview of approximately twenty minutes and will to take place in a mutually agreed upon location at a time convenient to you. You may decline to answer any of the interview questions if you so wish. Furthermore, you may decide to withdraw from this study at any time without any negative consequences.

With your kind permission, the interview will be audio-recorded to facilitate the collection of accurate information and later transcribed for analysis. Shortly after the transcription has been completed, I will send you a copy of the transcript to give you an opportunity to confirm the accuracy of our conversation and to add or to clarify any points. All information you provide is considered completely confidential. Your name will not appear in any publication resulting from this study and any identifying information will be omitted from the report. However, with your permission, anonymous quotations may be used. Data collected during this study will be retained on a password protected computer for **5 years** in my locked office. There are no known or anticipated risks to you as a participant in this study.

If you have any questions regarding this study or would like additional information to assist you in reaching a decision about participation, please contact me at Zambia Institute of Special Education or by e-mail at gchisanga5@gmail.com.

I look forward to speaking with you and thank you in advance for your assistance in this project. If you accept my invitation to participate, I will request you to sign the consent form which follows on the next page.

Yours sincerely

____

****

CONSENT FORM

I have read the information presented in the information letter about the study on **Teaching Practical Lessons in Integrated Science using Mobile Laboratories: A case of selected basic schools in Zambia.'** I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and add any additional details I wanted. I am aware that I have the option of allowing my interview to be audio recorded to ensure an accurate recording of my responses. I am also aware that excerpts from the interview may be included in publications to come from this research, with the understanding that the quotations will be anonymous. I was informed that I may withdraw my consent at any time without penalty by advising the researcher. With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

Participants Name: ……………….

Participant Signature: _______________________________________

Researcher Name: …………………..

Researcher Signature: _______________________________________

Date: ____

Appendix H: Mobile Laboratory

Source: (https://www.lusakatimes.com) **(internet)**

Appendix I: Launch of Mobile Laboratories in Zambia

ON 8 AUGUST 2013, H.E. MR. AKIO EGAWA, AMBASSADOR OF JAPAN LAUCHING MOBILE LABORATORIES IN ZAMBIA


Source: (https://www.lusakatimes.com). **(internet)**